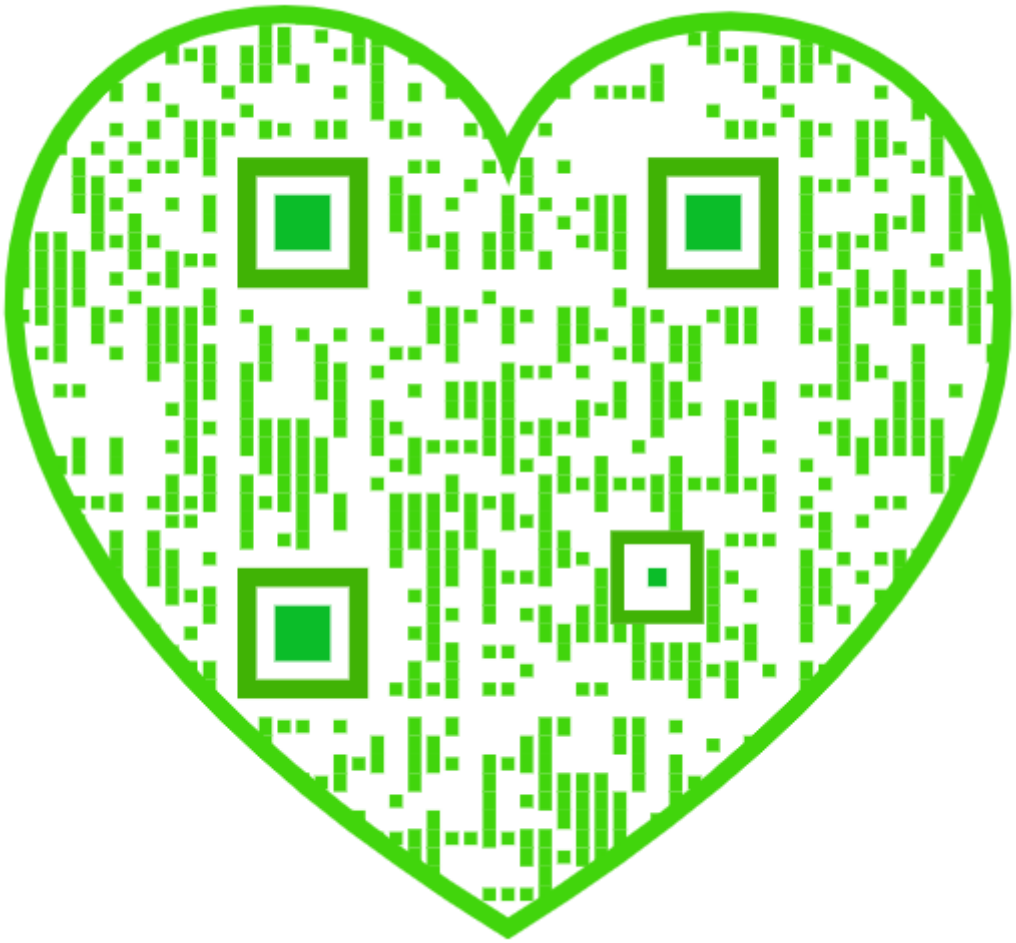
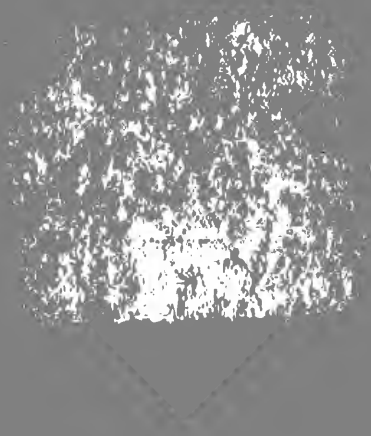
SD
333
S37



LIBRARY OF CONGRESS.
Chap. SD373 Copyright No.
Shelf .S37
UNITED STATES OF AMERICA.



"American Forests."

By Prof. P. P. Schotzka,

Author and Proprietor,
No. 611 Twenty-fifth Avenue South.
Minneapolis, Minn.

FEB 10 1892
33514

Entered according to the Act of Congress, in the year 1887, by
P. P. SCHOTZKA,
In the Office of the Librarian of Congress, at Washington.

S3
.S37

PREFACE.

A country without a tree on her face,
Is to be compared to an empty space.

Their alarming disappearance and the fact that they are mostly given up to unscientific management convinces the author of this treatise of the fate, which sooner or later, must befall our once so magnificient primeval forests and urges him with earnest desire to do his part towards preventing the approaching calamity.

Seventeen years ago he sent a memorial to Congress, calling attention to the importance of forests and the necessity that the government should take the subject in hand and prevent their wanton destruction, and although his efforts were unavailing, also his lectures upon the same subject in after years, he still adhears to his ideas and is convinced that it is the duty of every citizen to pay more attention to a subject, the importance of which has been up to the present time so inexcusably neglected.

The author of this book understands the management and culture of forests, as he has received a thorough education thereof in one of the best academies of forestry in Germany, and added to this a vast amount of practical knowledge during many years of actual service. Thousands of trees which have been planted under his direct supervision bear testimony that the task of replacing partly destroyed forests can be successfully accomplished. The condition and management of our old forests must implore every citizen that under the present system their existence is endangered, since their mission is unappreciated, and their usefulness and absolute necessity unacknowledged. But the time is coming when the consequences

of the present management will be apparent to all, and the punishment merited for their ruthless destruction be meted out. Then the proverb, "Want and necessity generally grade the road for the better" is verified, as then the teachings in regard to their value will receive the attention of all; but then it will be too late! Nature will not change her laws. The same consequences which accrued after the destruction of forests in other countries must follow in our own. This is a lesson for us. As a people it behooves us then to examine the matter thoroughly, to acquaint ourselves with the true condition of our forests and learn their sufficiency and deficiency for present and future demands.

In the following pages the author endeavors to publish such facts, make explanations and lay down such rules as he considers most essential for a better system of management, and which shall lead to a more thorough appreciation of the benefits of forests, and he cherishes the hope that everybody who loves his country may, while reading this treatise, have a due appreciation of the writers earnest desire and efforts to serve the country.

Any informatian upon the subject will be cheerfully given, and corrections and additional facts for the following editions thankfully received by

THE AUTHOR.

INTRODUCTORY.

Agriculture, horticulture and arboriculture are all parts of one great whole, namely: cultivation of the soil, and its various productions upon which the prosperity and existence of mankind depends.

Agriculture leads the van of this three-fold group, being the fundamental element of wealth and national advancement. Fertility of soil, variety of climate and wise selection of grains and plants, combined with energy, enterprise, skill and industry on the part of the inhabitants are sure guaranty of the prosperity of any country.

The farmer limits his efforts to the cultivation of those crops which are the best adapted to the soil and climate of his region. The gardener must know the entire list of vegetables, fruits and flowers without reference to latitude or longitude, and consequently their growing and cultivation must be more or less scientific. The attempt of scientific development of the husbandmans art in many of its branches dates back only half a century. Previous, both agriculture and horticulture have been conducted upon the "Virgillian System;" adherence to blind custom rather than by intelligent investigation and judicious experiments.

The first book in the English language which treats of the relations of agriculture and chemistry was published in 1795, and its teachings, though containing some truths, are absurd when viewed in the light of present attainments. No accurate analysis of vegetable life and structural developments was made until the year 1810, and as late as 1838 the Goettingen Academy offered a prize for a satisfactory answer to the question, "Whether the ingredients found in the ashes of vegetables are essential to growth." The last half century has placed agriculture upon a true scientific basis, and since then the advance has been simply wonderful.

But it is a startling fact that one of the most essential factors in securing these achievements has been almost, if not wholly ignored. Science, so

active and aggressive in particular directions, turned its face from one that would lead it to most valuable results.

The question as to what effect the forests have upon the cultivation of soil, the quantity and quality of its products, and upon the health and comforts of the inhabitants is scarcely suspected.

The Bureau of Agriculture at Washington has made some efforts in the direction of preserving the present area and extending the forest culture. The secretary of Interior has attempted to prevent the wanton destruction of growing timber on the public domain, and urged new settlers upon the open prairie to plant trees. But all this was more of an experiment, empirically, that is, not scientifically, with only incidental, one might say, accidental reference to the well known and established laws of nature.

The time has certainly arrived for full and intelligent consideration of this subject, and if the eyes of the nation are opened to its vital importance, the people will demand proper attention to it, as it is a well established fact that the forests of a country should cover from one quarter to one third of its whole area, if that country shall be healthful and its climate salubrious, fulfilling all the conditions under which agriculture may be successful. The extent, location and distribution of forests must also be taken in careful consideration. Every state and territory, every county and township should have its due proportion, if the utmost benefit to the entire nation is intended. In this we are all interested, as money can build and beautify a castle but cannot create a grand and majestic tree.

In Europe this has become of such importance that the governments have assumed control of the forests and established special bureaus in charge of competent officers, who after long and thorough apprenticeship, have graduated in the science of forestry. Thereby the forests have been made the means of promoting the health and fertility of the country, and a source of increased revenue to the government. The United States needs similar legislation. An intelligent oversight and authoratitive control by competent men may secure us the benefits to be derived from a proper management of the timber, yet within the control of the government.

Equal causes produce equal results or equal consequences.

This is the undisputable law of nature, approved in all ages and shown by the history of every nation as well as every individual. The statesman therefore, as well as the political economist, in fact every wise and intellectual business man, bases his calculations upon the truth of the above law. It is therefore a wise practice and policy to consult in new undertakings, those who perfectly understand the subject and be guided by their advice, especially in the culture of trees.

The population of the United States have so far enjoyed, even if not generally appreciated, such a surplus and abundance of forests and their

products, that a thoughtless and reckless destruction of them has by no means and under no circumstances been considered as anything improper.

Farsighted men have formed the "American Forestry Congress" and every citizen who has the welfare and prosperity of the country at heart should thank that body for their laborious task, viz: "That the care of the forests of the country should be placed in the hands of the government, and where practicable, in the hands of the state governments, so that their total destruction and thereby the diminishing of agriculture, health and commerce may be prevented."

Let us not think that the country has a sufficient area stocked with forest trees, but let us remember the time needed for their development and also follow the rule by which Europe is guided: "That a careless treatment of the forests can lead in a few years to such a condition of the same, that the best forester cannot relieve them during a century."

AMERICAN FORESTS.

CHAPTER I.

CONSEQUENCES OF DEFORESTING.

The dangers arising from destruction of forests are not exaggerated, if compared with the descriptions of ancient historians and the researches of travelers of a later date.

Robin, Peron, La Perouse and others have graphically described the fearful consequences which have followed such wholesale destructions on the Island of Trinidad, Martinigue, St. Domingo, Mauritius and other places. Instead of the luxurious vegetation which once abounded, resulting from the warm, moist and voluptuous climate, are now only seen naked rocks and bare hills. The dewdrops, fogs and refreshing showers have given place to hurricanes and cyclones.

Phœnicea and other provinces of Asia and Africa, once the graneries of Europe and inhabited by a prosperous and happy population, are now little more than arid deserts. Their glory has departed together with their forests. Chouseul Gouffier vainly searched the dominion of ancient Troy for the Scamander River; its bed had dried up after destruction of forests.

With the diminishing of forests in Spain, the water supply has been reduced, while in Italy the climate has become colder.

Australia furnishes another example and the Government, recognizing the cause, is taking steps to apply a remedy by tree planting.

The valley of the Durance, in the southern part of France, is endangered of becoming a stonefield for the same reason; the growth of Olives and Grapevines being retarded for want of shelter and moisture.

Switzerland gives numerous similar examples.

In Iceland agriculture was no longer successful after the departure of forests and the steppes of Russia, which were formerly fertile, are now deserts.

But on the other hand the cultivation of trees in Scotland, France and other countries plainly shows the great blessings which forests are.

Egypt has a perceptible increase of rainfall, since trees have been planted on a large scale. Those facts need no comment and all arguments to the contrary must fail.

CHAPTER II.

CAUSES OF THE DECREASE OF OUR FORESTS.

WHAT CAUSES REDUCED OUR PRIMEVAL FORESTS TO THEIR PRESENT NARROW LIMITS.

Ignorance, carlessness, selfishness and the idea that so vast a forest area could ever be exhausted or perceptibly diminished in size, have been the main causes of their destruction.

The weapons used have been the axe of the woodman and fire; especially the latter, as the work of the former, was, formerly hardly visible. The savage Indian done his part toward the burning of forests; he started the fire carlessly, and at other times to drive the game from certain wooded districts. Control over the elements having been entirely lost, vast areas have been swept away, filling even the souls of the savages with terror. Laterly, the squatter has set fires in order to clear tracts of land for agricultural purposes and as the soil has not yielded the expected returns, he left.

The lawful settler imitated the squatter in order to dispose of a superabundance of wood.

As immigration has increased from year to year, the war against the forests has been continued in a degree proportionate to the growth of the population. The gigantic old trees are gone, after having withstood the winds and storms of centuries.

If this clearing had been conducted with wise and correct principles, it would have been perfectly proper, as it was necessary to make place for farms and the building of towns and cities. But if some tracts of forrests had been spared, what a blessing they would be to those who are now settling upon the naked prairie. Cities and towns have arisen from the ashes of the forests, great industries have been developed, the demand for

wood has increased in all directions, and it has been taken, wherever most plentiful and easily to be obtained.

The late war caused terrible havoc among the forests, as in many parts of the country they were cut down by the armies to prevent the possibility of surprise by the enemy, and fires were set to cover the rear of retreating enemies and to serve as obstacles to the pursuing troops, and great fires like those at Chicago and Boston, have destroyed whole townships of forrest.

But let the causes of destruction be what they may, it is an undisputed fact that they were made in many cases on a basis altogether too broad, and that the prosperity of many states is on that account lessened. Trees grow very slowly and if cut too rapid their number will be gradually diminished, and they must finally disappear altogether, wherever this process is continued. If left to the sole care of nature for a period of one thousand years, she would in that length of time hardly be able to erase the footprints of human's attack by replacing the forests to their original condition.

The government still holds in possession extensive tracts of land which are mainly covered by forests, but to expect that the whole country could be supplied with wood from those alone is an illusion, the fallacy of which it would not take long to prove.

Upon the farmer and land owner rests the necessity and duty for the planting of trees and the renewing of forests, by devoting a certain portion of land to their culture. It is the duty of the government, as well as of state governments, to support the farmer in this undertaking in every possible way, and protect him by wise and effective laws and by actual assistance, such as instructing him in forest culture, exempting his forest land from taxation and by the most stringent laws in regard to prairie and forest fires. A beginning in this direction has been made, even if only upon a small scale, by different states, and their good example should be followed by all states and the government.

CHAPTER III.

FORESTS IN THEIR PRESENT AND FUTURE STATE.

In chapter I are shown the benefits derived from forests and also the consequences which have followed their destruction or even the rendering of their extent too small as compared with the area of a country. What an erroneous idea predominates in regard to the extent and inexhaustability of the forests of this country, will now be considered and for a more correct understanding of the subject, the forests will be devided into five classes.

1. Extensive areas, covered with trees, called "Second or Third growth." The entire or almost entire disappearance of this kind of forests is naturally and unavoidably a question of the near future. Each order, family and species of trees has a time when it comes to maturity, after which it must die. If the deciduous trees have been cut down before reaching their maturity, the stumps or roots will send fourth new shoots which will in turn grow into trees, and until the original stump has reached maturity of the first tree cut down, no matter how often these shoots may be cut, others will grow to take their places. But just, or at least nearly as soon as the stump has arrived at maturity, the formation of young shoots at once ceases and parent and offspring die together. The absurdity that cutting of succesive growths can be carried on for an unlimited period is fully apparent. It is not in unison with the workings of nature, consequently these forests will disappear.

2. Another class will occupy our attention, namely: those whose ranks are being annually thinned to supply our every day wants for timber and fuel. Their roots and stumps when not too old naturally send fourth new shoots, but very seldom do they grow to any size, as the cattle which are constantly grazing in these woods eat up all the young sprouts, as fast as they appear above the stumps and ground, and by their continual tramping over the ground, render it very hard, while at the same time owing to the scattered condition of trees, the winds are constantly blowing away the few

leaves, which would otherwise remain as the only natural fertilizer.

3. Another large forest area consists of portions of woodland situated in swamps and marshes. These frequently present the appearance of primeval forests, on account of a few large trees which grow there on little elevations, while by far the larger part, they are worthless shrubs. On close examination we find that even the larger trees have trunks which are decayed within, and are therefore of little value except for fuel. A sudden drainage of such places would inevitably cause the death of all trees there situated, as they have not formed large roots, but only such as would reach the waters surface. and consequently would not receive enough nourishment but should the drainage be carefully and gradually done, the roots would find their way deeper into the earth while searching for moisture, and at the same time the area will be greatly improved, as the organic deposits are often a yard in thickness, but are not in a condition to be digested by the roots of trees while under water, owing to an excess of moisture. Where drainage is possible, these forests must make room for meadows, and be sides forests to fulfil their mission in regard to climate, moisture, &c. should be situated on high land instead of in swamps, where their effect will be damaging to the surrounding country.

4. The extensive regions covered with evergreen forests of spruce and pine, from which have come in times past, and whence still we receive our supplies of that invaluable article, "pine lumber." While walking through the ranks of those once beautiful forests, the forester's heart is filled with grief at seeing the unsystematic and unappreciated manner in which these grand gifts of nature have been treated. Those forests should have been divided into squares by roads or avenues when first openings were made in them, which roads should have been kept clear of rubbish and high grass, to prevent, in a measure, the spread of fires, which have at different times, done such damage there, and have destroyed a vast amount of property. In five or ten years the fine forests, at least those in the settled portions, will belong to the things of the past.

5. The last class consists of those fine forests where as many healthy timber trees stand and grow as the condition of the soil and the best management can produce, such as will readily yield from seventy to eighty cords of wood to the acre, at the age of eighty years. In large forests which have been left untouched are usually found large openings which have existed either from the beginning, or have been made by trees that fell from old age, to make room for others which will rise to take their places. It is evident from the law of nature, that by no means can all the trees in these forests be healthy. Same old feeble and decaying trunks re-

main standing, being assisted by thrifty trees in their immediate vicinity. When these at last give way, in their fall to the earth, they must crush many of the young trees, leaving them behind in a more or less unhealthy state. If these forests could be left untouched, they would certainly take care of themselves, as nature always heals the wounds she makes.

CHAPTER IV.

FORESTS SERVE AS NATURES AGENTS TO FULFIL HER PLANS.

If we observe nature with the eye of experience and knowing her eternal and unchanging laws and see how the links in her chain fit one into the other; how the presence of each and every one is necessary to the whole system, we come to the conclusion that she needs for her use in her great laboratory all created things, great, small, solid, liquid or gaseous, vegetable, animal and mineral, and that they must be there for her service at the proper moment so that she may be enabled by means of those agencies to accomplish all her plans. For we know that what she connot produce now, she will in a thousand or million years if her agents are not disturbed. Forests are living bodies, composed of separate existences, each forming a minature chemical labaratory of itself and therefore nature's most necessary and useful servants and serve as agents in carrying out her plans.

1. Forests beautify the earth and improve the character of its inhabitants. That man is influenced by his surroundings is well known and in the present case how easy it is to note the difference between the dark and meloncholy expression of individuals who have been grown up among somber pines, and the cheerful, smiling countenances of those whose youth has been spent in bright, deciduous forests.

2. Forests help to sustain the relative proportion of the component properties of atmospheric air and purify it from unhealthy substances and obnoxious gases, since they inhale the carbonic acid gas, which has been exhaled by the animal creation, and exhale, instead, oxigen, absolutely necessary for animal existence, and most assuredly do they also absorb great quantities of the unhealthy matter contained in the atmospheric air, otherwise people living in forests would not be so healthy.

3. Extensive forests prevent sudden and extreme changes in temperature of the adjacent open country, as the air under the sheltering tree tops cannot be affected by heat or cold, like that in the unsheltered area. We

therefore have in close proximity to each other, two bodies of air, different in temperature, and for that reason, also differing in weight. There will then be a constant exchange going on between the air of the protected woodlands and that in open fields, since the warmer, light air will be forced continually to take those places which are deserted by the colder and heavier air. This change goes on until the air in both sections is so intermingled as to possess the same temperature and consequently the same specific gravity.

4. Abundant forests effect climate by regulating the moisture and electricity of the atmosphere, and in so doing, preventing protracted drought, or a superabundance of rain, and hindering those fearful electric tempests which are the curse of sparcely wooded countries. In most parts of the United States the yearly rain-fall, could it be evenly distributed throughout the seasons, is amply sufficient to supply all the needs of the animal and vegetable creation. The forests serve as reservoirs for the surplus water, for it is well known that owing to the slow evaporation of water under the shelter of trees, the air coming therefrom is always moist, even when that in the open field is dry. For this reason, more delicate and finer crops can be raised in the vicinity of forests than in exposed places, since some times in the long intervals between rainfall, this moisture-laden air is constantly refreshing the suffering plants, which otherwise wither away. Trees, and especially large forests, are continually drawing to themselves the electricity contained in the air and clouds, and conducting it to the earth, thus stopping undue accumulation and rendering less liable fearful electric storms. It follows as a natural consequence that forests supply the springs, rivers and brooks with water, prevent the washing of the soil from fields, and hinder those heavy floods, which in late years are of so frequent occurance.

5. The forests serve as a protection against grasshoppers, as in the shade of trees their eggs cannot be hatched, since they need the open, dry prairie. Prof. Marsh, in the Manual of Minnesota Forester association says: "It is only since the felling of the forests of Asia Minor and Cyrene that the locust has become so fearfully destructive in those countries."

6. Forests supply us with fuel and material for building and other purposes. Their value in this direction can hardly be estimated, but the carlessness with which the American people regard this, is conclusive evidence that they have but little thought of the intrinsic value of forests at the present time.

7. In a paper read before the Public Health Association, Dr. Geo. L. Andrew reached the conclusion: "That forests and tree belts are of undoubted value in preventing the dissemination of malaria," and, "that trees are of a positive sanitary value."

8. The forests formerly supplied us with game and fur-bearing animals, but they are gradually becoming less, as the forests are yearly reduced in extent imitations are substituted for real fur.

9. The forest furnishes many more useful and important articles, viz: Bark, for tanning and medical purposes, turpentine, resin, wild honey, nuts of all kinds, roots, herbs and blossoms for medical use, &c.

Here then, we have two pictures. In the one we look in the future and see wide-spread desolation, an extended, treeless country, visited by destructive storms, by severe droughts, with its streams dried up. In the other, we see a charming landscape, a rich fertile country, a population enjoying all the blessings which flow from peace and plenty, and so we must admit the necessity of commencing this great enterprise at once, and prosecuting it with vigor.

CHAPTER V.

TREATMENT OF FORESTS SO FAR NOT DESTRUCTED.

Forests, which have from some reason or other, so for escaped destruction, may be classified in the following order:

1. Groves of trees of nearly uniform growth, a portion of them old and decaying, partly young and slim, but equaling the older trees in height, and where, since there is no undergrowth, free entrance is given to the rays of the sun and to the wind.

2. Groves of trees of second or third growth. These are found quite thrifty on rich soils, with a considerable amount of undergrowth, most of them being slender and of small dimensions, so that easy access is given to the sun and wind. Here as the leaves are being continually blown away, the soil is year by year growing poorer.

3. Evergreen trees interspersed with an undergrowth of smaller trees and shrubs.

4. Lines of trees along the banks of rivers, partly decayed, but of second growth, where they have been of easy access to farmers.

5. Scattered, low, scrubby trees, growing upon hills and mountains among which are often found bare spots, sometimes of the size of a half acre. These yield but little profit to the owner, but still they are scaled and recorded as forests, in the census.

6. Pine forests, into which great inroads have been made, and where the bare places produce only a few shrubs of a deciduous nature, the seeds of which have been blown and carried on from distant forests, and being stopped in their flight by the pines, have been deposited until an opportunity for germination was given them, which took place as soon as the original trees had been cut down.

a. FORESTS OF THE FIRST CLASS.

The soil, where these forests are growing is gradually losing its productive qualities, and the old trees are rapidly becoming poor and of little value. Before commencing to plant trees on any new acres, cut down the old trees, and those which are apparently making no increase in growth, and leaving the young and thrifty standing, but in not so large a number as to shade the ground too much. Plant over the whole extent, the same as if no trees were left, so that in the future the undergrowth may be serviceable for fuel. For the overgrowth, use such trees as to not give too dense a shade, taking care in planting them among those which are intended for fire wood, to set them at proper distances from each other. The best trees to use for timber or overwood, in such cases are Red, White and Burr Oak, Elm, Hackberry, Black, and White Walnut, White Birch and the Larch, (limited). The best trees for the undergrowth are such as will thrive well when shaded, and will sprout out again readily from the stump, after being cut off. Of these may be named: White Beech, Hophornbeam, Ironwood, Elm, Ash and Maple; also Linden, but this latter tree only where shading of the ground is the main object to be attained, as the wood is of little value for fuel.

After newly planted trees have reached the age of twenty or thirty years, some can be selected for timber and the rest cut down. Care must be taken to cut as close to the ground as possible, so that the new shoots may come out close to the roots. If any of the original trees have reached maturity by this time, or are not gaining in size, they should also be cut down, and some of those which have been planted, left standing to fill their places. Such a forest should be so managed as to have the timber trees of all ages, so that it is not necessary to cut too many at one time. The following will be a guide as to how many of the trees be left standing:

An average tree, growing singly, will cover with its branches at the age of one hundred and twenty years, 226 square feet; when ninety years old, 132 square feet; at thirty, 64 square feet; at five years, 20 square feet; so that one hundred and ninety-two trees at the age of 120 years, will cover just an acre, while it will take three hundred and thirty 90-year-old trees, or 680 of an age of 30, to cover the same ground. These are supposed to be all grown as single trees, and having full growth, branches and their tips just touching. As a rule, not more than three-tenths of the area should be covered by the branches of the overgrowth, when thirty years of age, and about one-half when the most of the trees have come to maturity. It should be mentioned, however, that the large timber trees may be and indeed should be pruned, and that the undergrowth, when too much crowded, should be thinned out.

In mountainous regions, an entire cutting down of trees is dangerous, since the replacing of them by planting is very difficult, if not entirely impossible. In such places the method just mentioned is the most advisable, as, should the place be totally cleared, the soil will be washed away, and the burning sun will kill all vegetation. In such exposed situations, it is sometimes necessary to adopt the plan of cutting down only the matured trees, after enough young plants have sprung from the seed to abundantly supply their places.

Forests growing upon quick-sands must be very carefully handled, so that the wind may not have an opportunity to sweep through them. The shores of Lake Michigan furnish examples of the harm which may be done by the quick-sand, when set at liberty. Under all circumstances the rule holds good, that the ground should be kept well covered and shaded, and the more strictly this rule is observed, the more will the soil improve, the better and more rapid will be the growth of the trees, and consequently the financial returns from land.

In the selection of trees to leave standing for timber, we should in general take such as have grown up from the seed, or having been planted as single trees, only allowing some of the second growth in places, where there are none of the former. In this case the only alternative is to let some of the second growth trees grow until they bear seed, from which other trees may be propagated to supply the place of the inferior ones.

b. FORESTS OF THE SECOND CLASS.

This class of forest is called the "Low Forest." It depends solely for reproduction upon shoots which start from the stumps of such trees as have been cut down, and all trees must be cut down as soon as the proper time comes for so doing has arrived, which should be by the fortieth year of their age, but can be done much sooner with some varieties.

It is evident that the power of reproduction in this way cannot be everlasting; and if then their continuance is expected and desired, they need human aid. Since the largest portion of the forests in the settled part of this country is of this class, their disappearance is only a question of the near future. A tree over forty years of age is too old to be expected to produce sprouts from the sleeping eyes of the stumps, or the top ends of the roots, or at least they will be weak and thin. But if the trees are cut at the age of from twenty to thirty years, an abundance of strong and healthy sprouts will at once start forth, promising and yielding a rich harvest.

There is a certain age at which it is most profitable to harvest the trees of both the "high and low forests," which has in other countries proved most favorable in the case of different species. Willows, for baskets, etc., may be cut at periods ranging from one to two years. Locust, for

poles to support grape-vines, &c., and Hickory, for hoop-poles, may be cut at a period varying from three to five years. Willows in pastures and such as are used for head cuttings upon large trunks, may be cut once in five years, and all kinds of wild shrubs will produce the most wood when cut every tenth year.

Where the bark is used for tanning, it is best to cut White Oak once in fifteen years. The cutting must be done during April or May, and the branches and tops removed at once, to prevent the breaking down of the young shoots, which will soon make their appearance.

Willows which form trees, the so called Crake Willows, Birches, Alders, Aspen, &c, might also be cut at the age of fifteen years, especially in places where the soil is thin. Either of the species which we have mentioned, as being available every fifteen years, may be left until the twentieth, together with the Maple, Elm, Ash and Hophornbeam. All of the last mentioned, may be reserved to be cut once in twenty-five years.

The most suitable age for the cutting of all the most valuable species within the low forests for cordwood and many other purposes for which they are used, is at thirty years, and any trees which will be cut at that age may be left for five years longer, or until thirty-five years old, the Birch excepted.

The only trees which it is advisable to leave to the age of forty years, are the Oak, Red Beech, Elm, Ash, Maple, Alder and Linden; and these only in cold, mountainous regions. The more rigorous the climate, the greater the age to which low forest trees may be left standing.

As to the time of the year for cutting these forests, opinions greatly differ. Some maintain that it should be done while they are in the sap, and others recommending the winter cut. Experience has shown that the latter part of the winter is the best time, because in this case the cut on the stump is not exposed to the heaviest frosts, and at the same time has a little chance to heal before the sap begins to flow. In places which are sheltered and where the winters are not very severe, they may be cut without danger to the new growth at any time from the beginning of December to the end of February, except in localities where late frosts endanger the young shoots the cutting should be done in the sap to delay the young sprouts. This only takes place in low, swampy situations.

The reproducing power of the tree stumps within the "low forest," will cease upon the arrival at a certain age. To keep up these forests, resort to one of the following methods of procedure: On bare spots of ground, use young, growing trees, which have attained a thickness of from two to three inches for planting. Cut the roots of these trees from th side, farthest from the bare spots and then bend the trees to the ground, cutting off all branches from their under sides, fasten their trunks and the

single branches firmly to the ground, covering all branches with earth within a few inches of their tops, and leave nature to finish the work. The place should not be disturbed for at least three years, when there will be an abundance of young growth. If it is very difficult to cut off the roots upon one side of the tree, cut the trunks half through at a distance of about one foot above the ground, and bend them to the earth in the manner first described

2. Use plants larger than those of one year's growth from the stumps, and by cutting down a portion of the grove at a time, plant that place over with them, setting them four feet apart each way, and in commencing to cut down, take good care that the newly planted trees have enough shelter against the sun, and still are not too much shaded by the surrounding woods. Continue this process from time to time, until the whole grove is renewed. If this is intended for a "low forest," the first cutting of the young trees may be done in fifteen years, but if "high forest" is desired, they must be allowed to grow on until signs of maturity make their appearance.

3. In case no plants can be obtained, seed the place; distributing the seed in about the same places as we should set the plants if we had them. Should the ground be covered with sod or other such material, take out thick pieces, and turning them grass side down, drop seed in each place, distributing it over the whole surface, so that when in the future, plants have to be set out in their places, those left in the original spot are not injured. In case the ground is not covered with sod, loosen the soil before dropping seed. The young plants should be closely watched, so that they may not be overgrown by weeds, or become too much crowded. Cattle should not be allowed upon the ground until the plants have grown. The outer edges should be very thickly planted, that the wind may be kept from blowing away the leaves and the carbonic acid. If some trees, which are naturally of slow growth, should die, fill their places by others of the same size, or if smaller, of faster growing species, so that their growth may soon become equal to that of those around them, and no openings be left for the entrance of the rays of the sun or the wind.

c. FORESTS OF THE THIRD CLASS.

If enough trees are left to supply seed for the ground by the next good seed year, loosen the earth beneath the seed-bearing trees, to prepare it for the reception of the seed, and then look out for the necessary cover. At the same time, clear away the under-growing shrubbery, enough to let in a sufficiency of air and light. As soon as enough young trees are grown up, cut the old and look to the proper distribution of the young plants over the whole ground, which shall be covered by forest growth.

d. FORESTS OF THE FOURTH CLASS.

The management of these strips is quite easy and the retaining of them is of very great importance. During heavy rains, or at the sudden melting of the snow in the spring, the rivers rise rapidly and overflow their banks, washing away the soil from them, and sometimes changing their very beds, if there is nothing to prevent them.

The roots of such trees as grow along river banks are great preventatives to such occurrences, or at least hinder the waters from washing away the soil to a great extent. It is therefore needful to keep along the banks a continual growth of such trees as take deep roots, and to replace the old by young, before the former come to full maturity. The waters of rivers usually carry along in their current much of the seed of forest trees which has ripened upon their banks at one place and deposit it at other points further down. It is afterwards considerably scattered about by the wind, when the ground has become dry. It sprouts, and the places where it is deposited are soon covered with a growth of young trees.

e. FORESTS OF THE FIFTH CLASS.

The soil in places, covered by these forests is in general quite poor in quality from the nature of the case, since the few miserable trees which are with difficulty growing, can give but little hinderance to the free access of sun and wind. If the right attention had been given them, and the work of nature assisted instead of being neglected and abused, reward awaited the owner, who, by following a course guided only by blindeness, has now a lot of nearly worthless land. Such land might have considerable value if it had been cleared for the raising of farm crops in due time, but in its present exhausted condition, it has none worthy of mention. A gradual improvement of such places, by planting them thickly with those kinds of trees which grow readily and rapidly, such as Aspen, Poplar, Cottonwood and the like, and cutting them down so that they may be renewed at such intervals, is the best course to pursue. The soil when so improved, may be planted afterwards with trees more valuable.

f. FORESTS OF THE SIXTH CLASS.

Those areas of forests contain such large tracts of land that they cannot be easily handled by any one man, or even by a small community. They generally belong to the state or government and must be managed on a broader basis than those which we have so far considered, if it is the intention that they remain permanent forests. It requires a full and systematic division of the territory according to the classification of the different kinds of soil, the quantity and quality of the standing timber, the facilities for its transportation, and the denominating and selection of such as shall

grow there in future. In carrying out this plan a careful survey must be made of all the different grades of soil comprised in the area with particular reference to timber culture. The forests which at present are standing must be classified and an accurate description of the timber made, as to its age, quantity, quality, annual increase in growth, and all rivers running through them, adjoining cities, villages, railroad stations, &c, must be located and then replanted anew accordingly.

CHAPTER VI.

TREATMENT OF FORESTS IN THIS AND OTHER COUNTRIES.

The inhabitants of Germany in oldentimes esteemed forests most highly, not for the timber and fuel, but for the protection which they afforded them against enemies, as hunting places, as places in which to worship and offer sacrifices to their God, and finally as their homes. Of the danger connected with attacking them in their safe asylums, the usually victorious Romans had ample proof at the bloody battle in the Teutoburger Wald, where they were met by the Germans under the leadership of the great hero Herman. In those times the forests, like the air and water, belonged to all people in common. Whoever cleared any part of them for a field or meadow became by that act owner of that property and in this manner originated land ownership in Germany. Such a practice exists even up to the present day in some parts of South America. Later on this land-ownership was extended to larger tracts of woodland and the freemen, and more especially the nobles, took into their possession large areas of forests, which were situated near their farms and so became their owners.

The French Emperors also took possession of extensive forests and the officers of King Charles the Great were required to give an annual account of the condition of the forests in his dominions, and he gave rules to his subjects in regard to their management, which ordinances were promulgated under the title: "Capitulare Carolis Magni de Villis." In order to preserve the forests against law breakers, he appointed two classes of overseers. Those of the first class were denominated "Wood, Game and Forest Counts" and were officers of authority, ranking among the nobles. The second class consisted of freemen, called "Wood Messengers." The duty of both was to look after the game, and to take a general oversight of the forests.

The little value of wood in Germany, as late as the twelfth century is shown by an ordinance which appeared in the Cloister Mauermunster about

the year 1144, in reference to the burning of charcoal. Whoever desired to burn it in his forests, was obliged to pay for the permit, at Easter of each year, one hen and five eggs to the Cloister. In consideration of this, he was allowed to use as much wood as he desired for one charcoal kiln, and to take it in whatever place he chose; and not only was he permitted to use it for charcoal burning and fuel, but also for building purposes. But for the last mentioned purpose, he was required to consult the game keeper. But notwithstanding the great extent of the forests at that time, and the small value of wood, any person found guilty of wantonly destroying them, was subject to the most severe punishment. So a law was enacted, that, whoever set fire to the forests, should be bound hand and foot, and drawn three times through the fire; this being considered an expiration of his crime, should he survive. As late as the beginning of the sixteenth century, the German forests were in the main only important to their owners as hunting grounds. The wood had still very little value, excepting in those places where mining and ship-building were carried on. At this time the first "Forest Orders" were given: not with the expectation of any revenue being derived from the forests, but merely as a preventative against their destruction. After the thirty years's war, and the Weatphalien treaty in 1648, everything was changed. The great expense which had accompanied so lasting a war, had, as a natural consequence, brought much financial embarrassment upon the country. Resource was at once had to the forests as means of revenue, and more rational and economical management of them agreed upon. But the executors of the orders were entirely ignorant of forest culture, and having mostly just returned from the battle fields, paid more attention to hunting than to the culture ot trees and managemet of the forest.

During the latter part of the eighteenth century however, from gross carlessness in their management, and more particularly on account of the large increase in population and industries, and the turning over of large tracts into fields, the forests had disappeared to an alarming extent and the scarcity of wood was felt.

Political economists, supported by Frederick the Great, began to adopt measures to avert the impending calamity. Their attention was not only given to the government forests, but also by state regulation to private woods.

The forests had another important mission in the household of nature, besides the production of wood. That the government forests should not be managed solely with the aim of deriving direct financial benefit therefrom, that a certain portion of the country should be given up to forests, and their care intrusted to some one who should manage them in a manner conducive to the best interests of the country. Further, and for that pur-

pose, a forest training school was established for the education of men who intended to serve as government forest officers.

The state forests were accordingly surveyed, valued in regard to soil and quality of timber on hand, the annual growth of the same being ascertained and divided into blocks, and the whole area again into forest districts of convenient size, to be managable by one head officer, as district officer. Each officer of a district was provided with a description of it, as to the quality and properties of the soil, with reference to tree culture and with charts; one showing its outside limits and other necessary effects of his area; another, the different kinds of wood, in colors and their age at the present time, and finally, one which showed the condition in which that part of the forest may be expected to be after, say forty years from date. Besides this was shown the quantity to be cut annually and brought upon the market, which consists of an amount equal to that which the area gains annually by growth, if the forest be managed after the plan of the head department. Comparatively speaking, the interest, (yearly growth) only, was to be used, the capital remaining intact for the benefit of future generations as well as for the present.

In carrying out the work above described, it is evident that a vast amount of knowledge, practical and theoretical, is required, and that all the benefits to be gained from properly managed forests, cannot be realized, if their care be left entirely to private individuals.

France sold her forests to private individuals, and her people are yet suffering from this act. She pursued the policy that all trade and business is most profitable and safest in private hands, not considering that the care of forests is of an entirely different nature from any other business. Germany, on the other hand, guarded her forests and succeeded in saving them and at the present day the Germans hold them in the highest estimation, having inherited this reverence from their ancesters.

The following are the causes which have resulted in the preservation and maintenance of the German forests:

1. The economical use which was made of them.

2. The continuous passing of laws by the government in regard to forests and their uses, and their strict enforcement.

3. The replacing of trees which had been cut down, and the turning of such fields into forests as had proved to be unfit for agriculture.

4. The excellent forest police order and the strict guard which was kept against fire.

5. The government control of the private, church and domain forests.

6. The preventing of the pasturing of cattle and sheep among the young growth of trees.

7. And last but not least, for the reason that so large an area was under the direct administration of the government, as government forests.

Naturally the question arises: "Has anything of a like nature, and tending toward the same ends ever been done in the United States?" No.

How long shall this continue? The boasting remark is made: "As the demand increases and the supply be lacking, this thoroughly alive and intelligent people will find means and pass laws to replace the forest." But the building of a railroad, factory, or any other work of great magnitude which lays in human power to accomplish, is a different matter from the growing of forests, since trees cannot be made to follow human law in their development, but will grow but slowly in conformity of the decree of nature.

CHAPTER VII.

PREPARING SOILS FOR SEEDS OF FORESTS.

The more thoroughly and carefully the soil is worked, the better will be the growth of all productions of the farm and garden, and the more beautiful will be the harvest. But what is of such great necessity on the farm and in the garden, is a curse to the forest.

It was for a long time claimed by many so called authorities on forest culture that the same system, which was useful to follow in one case, must be of advantage in the other, and the thorough working of the soil for the reception of the seeds of forest trees was practiced the same as for other crops. But after many failures in places so worked, from the rapid drying up of the soil thus loosened, and the consequently drying up of the thinly covered seeds, as soon as they had sprouted and before they had received a sufficient amount of moisture to enable them to send forth their roots, this custom of working the soil was abandoned and declared not practical. Furthermore, the forester has to deal with localities, where the loosening of the soil renders it almost certain to be washed away, together with the seed which has been planted, and in other places neither the plow nor the harrow could be used at all. The foresters in Europe long ago gave up the practice of seeding the whole area upon which a forest was to be grown, but adopted the more rational system of raising the plants in a nursery or in so-called seed-beds at such parts of the forest as they should be needed when the trees which were growing, should be cut down. By this means the young trees have a few years start. The great advantage of the method when compared with seeding the whole place can readily be seen.

Since it will be quite a long time before any return can be realized from the money invested, we should practice as much economy as possible without defeating our main object of gaining a good yield. As most of the

plants grow very slowly in their infancy, it will therefore take several years before they cover the ground and stop the entrance of the scorching rays of the sun and the wind. The deeply loosened soil will have sent to the universe a large amount of organic deposits before the roots of the young plants can make much use of them. But if we first plant in the nursery and then in transplanting, only loosen the soil just enough for the purpose of setting and starting them well, we cause thereby a covering of the ground more quickly by some two or three years and at the same time prevent the growth of weeds, which are always showing themselves where the soil has been worked.

If we plant some fine, small seed of forest trees in well loosened soil, the action of the frost may do great injury in drawing the young plants, as we can see in the case of our winter wheat.

The loosening and preparing of the ground in places where we are obliged to use the method of seeding instead of planting, should only be so much as to enable the seed to have a good bed and a fit place for its future growth. Different systems must be used for different localities, which must be left to the judgement of the tree cultivator. Of course ground which never before has been broken, must be enough cultivated to give the soil the necessary sweetness.

CHAPTER VIII.

SELECTION OF SEEDS.

Should the farmer be able to gather his own seed, he should observe the following rules:

1. Seed should only be taken from well matured, well shaped and healthy trees, as when obtained from others it is either of poor quaility or worthless.

2. Those trees which stand singly produce the best seed.

3. Since the first seed which drops is usually affected by worms, or is for some other reason unfit for use, it should be picked up before the good and well ripened begins to fall, that the two may not be mixed, while again the last dropping seed is generally of an inferior quality.

4. All seeds should be dried sufficiently to prevent heating; therefore the sweating process is necessary before they are stored away, but great pains should be taken to avoid burning them, which may be prevented by repeatedly turning them over.

CHAPTER IX.

ADVANTAGES OF A NURSERY.

The advantages of starting the plants in your own nursery:

1. We can take better care of them upon a small bed than when scattered over many acres, by weeding, watering and sheltering them from hostile influences, and therefore the plants will be stronger and healthier and consequently better able to overcome the often unfavorable conditions under which they must grow on the open prairie, than those which are weak and sickly, and have been crippled in the germ.

2. In transplanting we can give to each plant the required room and good soil, and keep them better protected from the heat of the sun.

3. We have the use of a large area for the production of other crops, while the young trees are growing in this small space.

4. By planting in this manner we shall have greater certainty of success than in seeding on a large scale, and if the trees are small when transplanted and set out in land very near their original bed, failure is almost impossible.

Has the nursery been well cared for during the second year, as much ground sown to nursery as in the first year, and so on yearly, enough plants for setting out on five acres of ground each year, until the whole forty acres are covered by the young forest can be obtained.

CHAPTER X.

RESULTS FROM INCREASE OF POPULATION.

What influence will the increase of population, development of industries, the extensive mining of mineral and coal and finally the yearly building of railroads, and thereby increase of traffic and commerce have upon the future requirements of the forests?

As activity in every branch of trade depends upon and is more or less guided by existing conditions, so also should the manufacturing wood products. The forester in reference to the requirements of the time or market will adopt a course more in harmony with our progressive age and the unfolding history of the human race.

The chief points for consideration is the rapid increase of population, the fast developing industries, the discovery and mining of unlimited quantities of coal and the unparalled building and extension of railroads, consequently increase of traffic and commerce.

The increase of population is a well known fact, and as a necessary consequence, the consumption of wood is growing every day. Owing to the abundant supply of coal, the consumption of wood for fuel must of course in a certain degree diminish and prices become lower, and the forester, or so long as there is no forester, the farmer must be guided by this fact in managing his forests, to plant such trees as at maturity will have a value in the markets. Steam furnishes a great motive power for the machinery, and were it possible to make use of wood alone in supplying and feeding this great motor, it is evident the time would have already arrived where not a stick would be left in the country and therefore the great importance of coal cannot be over estimated.

The extensive use of wood in the preparation of charcoal will in the future be greatly diminished, since coke will take its place, except in

places where wood is very abundant and cheap, and charloal cannot be utilized near where it was made.

It is by all means probable that hereafter the owner of woods and the tree cultivator will attend to the production of timber as alone profitable, and only of such timber which is liable to fail soonest, namely, spruce and pine.

CHAPTER XI.

PRODUCTION OF TIMBER.

To produce valuable timber we must understand how to do it. The farmer, upon whom so much depends, usually raises on his land the wood which he may need for many mechanical purposes and for fuel. Those purposes are widely different in their nature and kind, and so must also be their woods planted and cultured. The new forests, to meet the requirements of the future, should be of a different nature from those at present existing. The trees should be all straight, with trunks like candles, without branches until reaching a point at least fifty feet from the ground when matured, so as to give from 90 to 95 per cent. of their wood for timber.

Two possibilities must be taken into consideration. Whether we have to deal with forests which are already in existence, or to plant new ones; and the following suggestions are given for the benefit of those who are unacquainted as to soil, situation, moisture, climate, &c.

Instructions and directions: On entering a tract of land of 160 acres, with the intention of devoting one-fourth, (40 acres) to forest culture, first examine and from it select that portion most unfit for tilling and divide the remainder to the best advantage for the various crops, which it is desirable should be raised upon it.

The condition of the vegetation and the degree of luxurience in its growth, or the greenness of the sod, and the nature of the ground, whether even or broken, will serve as guides in the examination, and determine as to the place of the grove. If there is no difference of quality in the soil, a place should be chosen where the trees, when growing, may afford a shelter to crops against the prevailing winds. The leaning of single standing trees, to one or the other part of the horizon, will aid us in arriving at a conclusion in regard to this point. In order to be successful, a knowledge of the varieties of soil and change of climate is essential, which can be obtained by observing the growing upon your neighbor's land. The next

thing is the preparation of a strip of land, in the most sheltered part, and if possible, near the water, as a nursery for the production and starting of the plants required. The following spring, having obtained some good seed, plant it there in rows like peas or beans. If the seeds are large, they must be covered to a considerable depth, but if small, but lightly. Acorns should be covered to a depth of from three to four inches, and other nuts three inches. Maple and Ash seed, over half an inch, and in general small seeds a little more than their thickness. It is very important that the earth should be pushed down quite heavily upon the seed which has been planted, with the back of an iron rake or like instrument, that a drill may be kept over it, sunk a little below the surface of the ground, for the better retaining of the moisture.

The seeding should be done early in the spring and the young plants shaded from the sun, especially Spruce and White Spruce, but the shade should be gradually diminished as the plants grow older and less delicate, that they may become used to their future situation. Since the trees raised in the nursery should be transplanted when two years old, they may be, especially the Evergreens, planted quite thickly in the seed bed.

Yellow Pine and European Larch need very little if any shading. After the seed has been sown, it is only necessary to keep down the weeds and water the ground when very dry. The watering should be done in the morning, not very frequently, but thoroughly. If the seed has been good and the watering not neglected, at least during the period of germination, plants thus raised will thrive much better than those brought from other places, which latter suffer from exposure to the sun and wind, and besides, have in general, been raised in a different soil and climate from that in which they must exist in future. It is important that the seed drills should be situated upon level ground, so that the seeds may not be liable to be laid bare or washed out by the rain.

CHAPTER XII.

MATTERS TO BE CONSIDERED IN FORESTRY.

The recommendation to keep the land upon which forests grow, protected from the sun and wind, is based both upon science and experience. Many, who are in other respects, very practical farmers, are always thinning out their groves and cutting off branches as high up as they can reach, claiming that trees grow much better when thus exposed to atmospheric influences than when too much shaded.

Farmers who use lime upon their fields for any great length of time for fertilizing purposes are doing to those fields very nearly the same thing, as these others just mentioned, are doing to their forests in thinning them out and allowing too much sun and air to enter. It is a property of lime to decompose vegetable and animal matter contained in the soil, and prepare them for immediate digestion for plants; in other words, it prepares food for plants much more quickly than the tooth of time, the atmosphere, would accomplish the same result. The growth of plants is therefore much more rapid when lime is made use of as a dressing, but can the fact be disputed by any reasonable-minded individual, that there must be a correspondingly rapid exhaustion of the soil? Hence we have an explanation of the old saying: "Lime makes rich fathers, but poor children."

Something similar takes place in the forest when the earth has been suddenly exposed to the influence of the sun and the oxygen of the atmosphere. The decay of the organic deposits is hastened, and so long as this takes place and the supply lasts, the trees will grow with increased vigor, but when these are exhausted, there will be an immediate reaction; they will become stunted.

Frequently the farmer, misled by the luxurient growth of forest trees, cuts them down and turns the woodlands into cultivated fields, only to find his confidence betrayed and hopes futile, when, after a few years, the

vegetable deposits left by the trees, having been used up, these fields refuse to yield the expected returns, since the soil is only adapted to the production of trees, and that only so long as they themselves kept it in proper condition for that purpose. It is therefore necessary to thoroughly examine the soil before such a radical change is made and to give to the field what belongs to the field, and to the forest what belongs to the forest.

Large areas of forest have the same influence upon the moisture of the atmosphere as a large area of water surface, since both keep the surrounding air moist. Small groves cannot retain this moisture as well as large forests, and it is therefore profitable for farmers to associate themselves together so that their tracts of forest may lie contiguous on the section line. Thus for instance, six farmers might agree to each have forty acres along the northern limits of their farms, for forest growth, in which case they will all have a fine shelter against the north winds, as well as a solid piece of forest, consisting of 240 acres. Again, if those occupying the opposite section should do the same thing, all will not only have protection from the north winds, but also those dwelling on the north will get moist air from the forests of their neighbors on the south, instead of having their crops damaged by those dry winds which usually blow in the months of July and August.

CHAPTER XIII.

SELECTION OF TREES.

The soil necessary for the growth of trees, and different other matters pertaining to it, must be earnestly considered to avoid expensive experiments. In selecting trees for any locality, observe what species are already growing there, either by new planting or by natural process. The following trees have stood the test and will serve the purpose for which they are intended, as forming the forests of the future:

a. DECIDUOUS OR SUMMERGREEN.

English Name.	Botanical Name.
White Oak.	Quercus alba.
Burr Oak.	Quercus macrocarpa.
Swamp white Oak.	Quercus bicolor.
Black Oak.	Quercus tinctoria.
Scarlet Oak.	Quercus coccinea.
Red Oak.	Quercus rubra.
Hickory, scaly bark.	Carya alba.
Hickory, white.	Carya tomentosa.
Hickory, red or pignut.	Carya porcina.
Hickory, bitternut.	Carya amara.
Walnut, black.	Juglans nigra.
Butternut.	Juglans cinerea.
Maple, sugar.	Acer saccharinum.
Maple, soft	Acer platanoides.
Ash, white.	Fraxinus alba Americana.
Ash, black.	Fraxinus sambucifolia.
Ash, blue.	Fraxinus gaadrangulata.
Elm, white.	Ulmus Americana.
Elm, red or slippery.	Ulmus fulva.

Linden or basswood.	Tilia Americana.
Hackberry.	Celtis occidentalis crassifolia.
Beech, red.	Fagus sylvatica and ferruginea.
Beach, white, (hoophornbeam.)	Carpinus, Americana or betula alba.
Locust, yellow, and varieties.	Acacia robiniana.
White Birch.	Betula alba.
Black Birch.	Betula lenta.
Red Birch.	Betula rubra.
Alder, common.	Alnus communis or glabra.
Chesnut, eatable fruit.	Castanea vesca.
Platanus or white wood, also Sycamore.	Platanus occidentalis.

b. EVERGREENS OR CONIFERS.

English Name.	Botanical Name.
Spruce, Norway.	Abies excelsa.
White Spruce.	Abies alba.
Spruce of Rocky mountain.	Picea nobilis.
Pine, southern yellow.	Pinus australis.
Pine, black Austrian.	Pinus nigra Austriaca.
Pine, Scotch.	Pinus Sylvestris.
Pine, Weymoth or white.	Pinus strobus.
Larch, European.	Pinus larix Europaea.
Red Cedar.	Juniperus virginiana.

The requirements and propagation of the aforenamed trees are:—

The White Oak. This tree has a wide distribution and grows to a great size, attaining under favorable conditions a height of 100 feet, and remains green for centuries, but it will become hollow in old age. Trees from three to four feet in diameter are not rare. It exists and grows in great varieties of soil and situations, but with very different results. It prefers situations at or near the foot of hills, and for radid growth a rich loose loomy soil and a deep subsoil, but does quite well in that which is sandy and mixed with organic matter if moist and not shallow. In thin soil or on high mountains, it never reaches perfection, but grows hollow and the top dies.

The Burr Oak. This tree differs very little in its requirements and usefulness from the former, but will grow quite well on the edges of swamps yet it does not attain the dimensions of the preceeding.

The Swamp White Oak. Forms quite a tall tree and prefers low ground. It must be cultivated as explained by the White and Burr Oak.

The Black Oak. Is a fast growing but short lived tree, producing a mass of branches which soon die from below. It does well in a crowded condition. It grows on rich and poor soil, but of course with different

results. It must be cultivated in the same manner as the two species first mentioned.

Scarlet Oak. This tree grows in moist soils, but as it does not attain a large size, therefore its culture should be limited to the above named localities.

Hickory, scaly bark. This tree is easily satisfied with the soil, if it is only deep, and for the production of nuts, a rich soil should not be selected. Trees growing in a forest in a crowded condition are not likely to bear fruit; they should stand singly to give them the room needed for this purpose. They grow to a large size if on proper soil, and if timber is the aim, should be crowded to make them grow tall instead of spreading, and with branchless trunks. The cultivation is a little difficult, as the nuts refuse to sprout when planted. The best results may be expected if they are planted in a nursery close together, soon after they fall in October, three inches deep and covered with a layer of leaves a few inches thick and transplanted the second year, wherever wanted, as later the top root is too long and difficult to handle. Great care must be taken that this root is set to its full length in the earth, without allowing it to bend in the least. However, in places where the ground remains moist in the summer, much larger trees can be transplanted and their top roots cut off during the process, without doing any particular damage, but in dry places this practice must not be followed.

White Hickory. This tree grows best and supplies the best wood if planted on high and quite dry places, among other trees. It does not attain the dimensions of the former, either in height or thickness. Plant the same as above and transplant among other trees.

Red Hickory, and Bitternut Hickory. Both the above are less valuable, do not grow to great thickness, and may be sprinkled among other trees in a forest, where they keep up in height to them. They do not form large tops when crowded and can grow quite close together.

Black Walnut. In order to have fine, branchless trunks, the young trees should be planted quite close together, about four feet apart each way. It is no use to try to raise them on poor soil, as they will not repay the labor unless planted in a rich, deep calcareous loam which contains an abundance of vegetable muck, (humus). In low lands, where soil has been washed in, they will grow to a height of from eighty to one hundred feet, with from fifty to seventy feet of branchless trunks. They will also grow with other trees on high ground, after these have deposited enough organic matter, and the subsoil is good and deep. The timber of those growing on high land is harder than that of others, as being closer grained, but the time of harvesting them is delayed, provided a certain thickness of trunk is desired, as they grow but slowly. They will

reach an age of eighty years in perfect health, but after that will begin to lose their vigor.

The Black Walnut, as well as the Butternut, can be transplanted when six inches in diameter for ornamental trees, but as their folliage is rather thin, especially as they approach maturity, and they do not live to a great age, they are not very desirable for shade, besides both are great cross-feeders and their leaves injure the grass where they fall, so that cattle will not eat it. They should not be planted around houses or in pastures. If it is desired to raise them for their nuts they may be set in the rear of houses or in barn-yards.

Butternut or White Walnut, is not so valuable a tree as the foregoing, nor does it grow to so great a height. It grows best on river banks, but does quite well on higher ground. When standing alone, it occupies a large space with its wide-spreading branches. All the nut-bearing trees which we have described, have compound leaves which very nearly resemble those of the Ash. If the seeds (nuts) are kept in the house during the winter, they become too dry and refuse to sprout or germinate when planted. The best way to preserve them is to put them in sand in the cellar, or cover them with leaves in the open ground. Mice and squirrels must be kept away. The uncertainty of their germinating makes it advisable to plant them in the nursery and transplant them when two years old.

Sugar, or Hard Maple. This is the best known tree in the country where it grows, and deserves its prestige fully, not only for the sugar obtained from it, but for its fine wood. Maple sugar is too well known to need any description, as is also the value of its wood for fuel, to most people, as it commands the highest price in the market. The timber is much used for cabinet work, and for this purpose the trees should be cut down below the stumps, since the lower part is often of more value than all the rest of the tree, on account of its beautiful speckles, or spots, so desirable for ornamenting furniture, &c.

The Sugar Maple grows best in low lands, but will do very well on mountains, and as it gives an abundant shade and a great mass of leaves, which decay rapidly, it improves the soil greatly and prepares a good bed for its followers. The young plants thrive better when shaded, but as such shade cannot be had upon a large area, it is best, as a rule to start them in a nursery and not to transplant till they are two years old. The seed ripens at the end of September and during October, and can be gathered easily. If it is to be saved until spring, it may be collected, and, after being turned over to keep it from sweating or heating in the beginning, burried in moist sand with which well mixed it must be planted early in the spring. If preserved in the house great care should be taken to avoid too much drying. It retains its germinating qualities for two years, if well treated.

The maple family does well upon mountains where the soil is loose and mixed with stones. Forests composed wholly of these trees are only to be found upon rich soils, but they will greatly advantage other kinds with their foliage, if sprinkled among them. They will not flourish near the ocean.

Soft Maple. This tree is very easily raised and of rapid growth. It spreads more into branches than the former, and the wood is inferior, but must be cultivated in the same manner. The seed ripens in June and drops off. Forests composed wholly of these trees are not desirable, as they are veey easily broken down by the wind, which destroys their value and makes their culture of little use under such circumstances; neither should they be planted with the Sugar Maple as their growth is twice as rapid.

The general rule with Maples, Ash, and even Elms, is to plant them in the right soil or they will not do well, as they are more particular in this direction than other trees, with probably the exception of the Soft Maple, which seed ripens in June and which grows on almost any soil.

White Ash. This tree flourishes only in places where there is an abundance of moisture but not too much, as it will not grow in swamps or marshes. But along the banks of rivers and upon soil which has been washed in, it thrives in a wonderful manner, while it does poorly on higher places, especially on the south side of hills. In a crowded condition it forms a trunk clear of branches almost to the very top, and becomes a valuable tree; if plenty of room is given for spreading it makes a fine shade tree.

Black Ash. This tree is called by some, Water Ash, as it is generally found growing in swampy places, where it does well, but the water must not be entirely stagnant, but must have some chance to run off, and the wet condition of the place must have originated from springs, which can be detected in some higher places. As such localities generally derive their swampy nature from the condition of the soil, which lets the water through very slowly, a drainage can easily be effected and the soil made fit for more valuable purposes. Culture with spruce would be advisable if it were not for the late and early frosts which occur in such wet places.

Blue Ash. This is a valuable tree and grows quite well in dryer situations than the White Ash; forms a fine tree and furnishes good timber. Seed of all Ash varieties mentioned, ripens late in the fall and is quite hard to gather, best to cut down some trees for that purpose. Expose it to the frost, otherwise the young plants will make their appearance the second year after seeding.

White Elm is a tree highly esteemed both for ornament and shade, as well as for the forest. It can be trimmed to grow in the most beautiful shapes, like pillars supporting arches. It is therefore most desirable for

planting along the sides of streets and roads. When Elm trees grow crowded together in the forests they form long, branchless trunks, of which the upper end is of nearly the same diameter as the lower. But when thus situated, they do not grow to as large a diameter, as when standing singly. They thrive in rich, moist, loose soil, but prefer one which is rich and loamy, near rivers, although on poorer land they grow quite well. They prefer the sunny, or southerly side of a hill, and are more at home in a warm climate than upon the cold western prairies; still their degree of hardiness is sufficient for enduring the existing temperature. They do not flourish well on the sea shore.

The seed ripens in May and June and drops at maturity. If sown as soon as ripe and attention is paid to watering, the plants will grow enough the same season to overcome the severity of the winter temperature, but if saved until the next spring it must be well spread in an airy loft, and turned often until dry, after which it should be put into bags and hung up in a cool, shady place. Its germinating power lasts only one year. In very cold climates it is surest to sow in autumn and cover with a thin layer of leaves or other protecting material until spring. The small seeds should only be put into the seed bed together with earth.

The best course to pursue and a method which is cheapest and safest for all private indivuals, is to plant it in a nursery from which the young trees may be afterwards carried to the places in which they are finally to grow, excepting wherever the forests are to be renewed directly from trees which are left standing for seed and as a protection of the young plants against atmospheric influenees, of which we shall speak hereafter.

Red, or Slippery Elm. This tree is a rapid grower in rich, loamy soil. It is a coarse and straggling tree when standing alone, but gains material fast in crowded forests if in proper soil. The timber is coarse as the appearance of the tree itself, but is quite durable, and posts made out of it if charred by fire at the part which is to be set in the ground, and a foot above, will last for a long time. The bark is used for medical purposes and many trees are spoiled by those who strip it off in the spring. The culture is easy and the same as that of White Elm.

Linden, or Basswood. As an ornamental or shade tree, the Linden takes the front rank, but forests should never be entirely composed of it; still, when sprinkled among other species which have thin foliage, it is an excellent means of keeping the ground shaded. The seed ripens in October, and falls off soon after, although part of it remains on the branches all winter. It requires the same treatment as Maple seed. The Linden is very easy to cultivate, and hardy. It prefers a low situation, but grows in almost any soil. The seed should be soaked for forty-eight hours in hot water before sowing. There are several varieties of Linden, but they all

require the same treatment. In Europe they have two distinct kinds, called the Summer and Winter Linden; the latter growing on high mountains and forming, in Russia, a lofty tree. It deserves as good a place in our forests as any other tree.

Hackberry. Mention is made of this tree because it is a native and quite common in our remaining forests, and not on account of its usefullness, since it possesses very little value, and so much the less, as it requires a soil where much better trees can grow.

Red Beech. The Beech is the tree best fitted to grow on mountains, but thrives best on those of middling height in temperate climates. It does not require so deep a soil as the White or Burr Oak, but is hardly ever found in sandy soil, unless this is at the same time very rich, preferring that which is composed of basalt, graywake and clay slate. The seed of the Beech like that of the Oak, ripens in October, and can be gathered only on sunny days when the air is dry, as, like the Chestnut, it does not drop when the air is moist. It can be preserved during the winter in boxes of dry board or saw-dust, and should be sown in the nursery early in the spring and the plants well shaded, as this tree likes shade when young.

White Beech. While the trunk of the Red Beech has a smooth cylindrical form, the White Beech, or Hophornbeam, has one which is uneven and very much turned and twisted. It grows in almost any kind of soil, but prefers low, rich land. Swamps, and hot, sandy soils are detested by it; neither will it thrive on high mountains.

The ripening and treatment of the seed is the same as that of the Ash, except that it can be more easily obtained. As it is hard to clean it on account of the long seed-wings attached to it, the best way is to thresh it with flails and winnow it like beans. It lies in the ground a year before sprouting.

Locust in varieties. The common, or yellowish green Locust is the most common. It grows to a considerable height, with a diameter of trunk, at a point three feet from the ground, of from two to three feet, but it will generally be cut down when fit for railroad ties or even fence posts. It thrives best in a rich sandy soil or loam, but will grow in the poorest and dryest, although very slowly.

The Locust is generally considered an ornamental, rather than a shade tree, and on account of the beautiful fragrance of its blossoms, which appear in bunches, like grapes, is a desirable tree to plant near residences. We generally find it along country roads and upon dry ridges. It has the bad habit of sending suckers from its roots all over the ground and is hard to handle, on account of its thorny or prickly branches. Of late the borer is attacking it extensively and injuring its growth as well as the value of

the timber. If grown among other trees their attacks may be diminished and probably entirely destroyed.

The seed ripens late in autumn and remains for a long time on the tree, sometimes during the whole winter. In some places where it grows we can find a plenty of young plants, and if the seed is sown in early spring, after saturating it for forty-eight hours in cow-juice, the plants are ready for setting out the spring thereafter.

White Birch. This tree is very valuable, for the fact alone that it will grow where few others will do well, but it has the peculiarity of not thriving in a soil formed of limestone or basalt, which is suited to so many species; otherwise it will grow in the poorest soil as well as the richest, but of course with different results. On high mountains and in pure sand, it grows better than any other tree. In stiff clay, however, it will not grow. White Birch trees will form forests by themselves, but as their foliage is thin, they do not improve the soil upon which they grow, and besides, their leaves do not easily decay, and being light are blown away by the wind.

The ripening of the seed is very uneven, as the process continues through the months of August, September and October. It falls off as soon as ripe. The cylinders which contain it, fall to pieces, or part into single seeds immediately thereafter and must therefore be watched. After it has been well dried it should be rubbed between the hands and sifted. It heats easily, therefore it must be spread out thinly on the floor while being dried. It is good for two years, but it is best to sow it the same fall in which it is obtained.

Black Birch. This variety seeks a more moist soil, along the banks of rivers, but otherwise is the same as White Birch.

Red Birch prefers the same localities as the foregoing: culture the same, also.

Common Alder. This tree requires a loose, moist, rich soil, with a low, sheltered and warm situation. It grows well in marshes and swamps, when these are not covered with stagnant water, and even flourishes although the roots may extend somewhat into running water. It produces an abundance of wood, if rightly treated. If it is cut down close to the roots, they will send out a multitude of young shoots, and the cutting can be repeated every fifteen years, the mother stump being able to send out new shoots for a longer time than any other of which we have knowledge. The cutting should be done in the winter, as the stump is loosened too much by the operation if the ground is not frozen. But if the marshes and swamps could be drained and converted into good land, it would not be profitable for the Alder alone to flourish there. It is a fact, however, that these trees, after they are well started, will naturally make the soil sweeter and even fit it for the production of more valuable wood.

The seed ripens in November and falls off in December, and in general, as the trees grow near running water, it can be fished out in the spring at places in the stream where obstacles on the surface have prevented its floating away. It must be sown as soon as dry.

Northern, or White Alder. This tree will in a manner, contrary to the Common Alder, grow on high land and upon lofty mountains, where it sometimes is a forerunner for better kinds which follow, and which would, without this pioneer, not succeed in gaining a foothold at such exposed points. Trees so easily raised deserve more attention than is given them, as they furnish us with the means for gaining our chief ends.

Chestnuts. The Chestnut requires a medium rich soil, but will not stand a very low tempearture or exposure, and is therefore a tree for warmer latitudes than the western prairies. The wood is valuable and the nuts well known and appreciated all over the country. These ripen in October and fall off on dry, warm days, and can be found anywhere in the market under the name of Chestnuts. Plant in the spring in a warm situation and transplant among other trees when about a foot high.

The Sycamore or White Wood. Is also found in warmer climates than the wetsern prairies. It is shade and ornamental as well as a forest tree, and grows to large dimensions with a fine trunk rising to the height of sixty feet without a branch. The tree is speckled on account of the scaling off of the bark. The leaves and seeds hang on long pedicles, the seed forming a prickly ball which ripens in October. The tree grows rapidly and is easily cultured. It prefers moist places along running streams, but is sometimes seen standing alone in fields and doing well.

The Tulip Tree or Yellow Poplar. Like the former this tree flourishes in the Eastern states. It is very stately, with a candle like trunk and growing to a height far above the majority of our native trees. It has flowers of the size and shape of a tulip, of a greenish white color. More attention should be paid to its preservation where the soil and climate permit its culture. It is the finest tree in the forests of the Eastern states, reaching as it does a height of nearly one hundred feet with an immense diameter, its trunk being without branches for over seventy feet. It chooses rich bottom lands, but I have seen it on high hills, though not reaching the dimensions just specified. The south side of hills should be selected for its growth and as much shelter as possibe given it from the weather, by other trees. Upon poor soil the top soon dies. The wood is rather light.

b. EVERGREENS OR CONIFERS.

The Conifers have only eggs and anthers. The seeds are not covered and for this reason they are styled Gymnospermae or naked seeded plants. We shall divide them into several classes. a. Such as have only one leaf

(needle) in a sheath. Among these are the White Spruce and the Norway Spruce.

White Spruce. This tree requires, in order to do well, a deep rich soil and a deep subsoil. It grows far up the sides of mountains, yet not as high as the Norway Spruce. Like the red Beech it reaches its best and most profitable age at 120 years and keeps in a healthy condition until 160 years old. On favorable soils it will grow to the height of 150 feet and contains more bulk to the same diameter at breast height than the Norway Spruce as its trunk is convex. It may be renewed in the same manner as the Red Beech, as long as we have to deal with existing forests of this kind, but as this is not likely we shall only see how it can be raised from the seed. The young trees during the first two years of their existance will bear to be quite heavily shaded, after which period they need more light, but again, after side branches have formed, they will endure a heavy shading and presure from overgrown wood, and when liberated will revive more fully than any other species of evergreens under like circumstances.

As the relative strength and elasticy of the White Spruce is less than that of the Norway Spruce, beams made from it will not support great weights, but it serves excellenty for bearing them when in an upright position, as in the case of pillars or shipmasts. The lumber made from it is excellent. We also obtain from it the so called Strassburger turpentine. The seed ripens in September and October and falls off together with the cone, leaving only its axis around which the seed and scales grow upon the tree. It is therefore necessary to watch its ripening and break off the cones before they fall to pieces, or else to spread blankets under the trees upon which it may fall. Six bushels of cones will give one bushel of seed with the seedwings on it. This seed must be spread out very thin on a floor in an airy loft to prevent its heating. The method of its culture will be shown and explained in the following pages.

Norway Spruce. This is the most useful of all the evergreens, as far as building material is concerned and should receive most willing attention and culture. It is the mountain tree. It likes a damp atmosphere and evaporetes a great amount of moisture. Alexander von Humboldt by experiment found that an area well and fully covered by a forest of these trees evaporate four times as much water as an equal area covered by water itself. Its proper home is on the mountains—more strictly speaking, on their northern sides—the sunny side, being warmer and dryer, which causes too great an evaporation.

This tree will even grow well on the sea shore, but not in marshes under stagnant wrter; still as it sends the roots directly under the surface, it can be made to grow on places quite low and moist when rightly treated and cultivated as described farther on. It will not flourish on hot sand or

stiff clay, but is suited with a soil of medium richness, and when well started will enrich the bottom for its own benefit. In too rich a soil it becomes affected with red rot, and from this cause will soon die, from which arises the idea that it will not live long in this country.

The seed ripens in October and November and drops from the cones the following spring, and if the weather is fine and warm, during sun-shine in the winter. The collection of the cones can begin in the latter part of November and be continued during the winter. The later this is done, the easier will the seed drop from them if warmed by a hot stove or in the sun on dry days in spring. In Europe they have regular factories where the seed is emptied from the cones. The seed can be left in the cones, in which condition its germinating power will last for seven or eight years, while of the clear seed when well cured, but fifty per cent. will be good at the end of five years.

Rocky Mountain Spruce. We would advise the trying of this tree in mountainous places on a small scale, and if success is promised, it would be a blessing for those parts of the country where other species refuse to grow, and fine timber is scarce.

Southern Yellow Pine. It is easy to say, "plant the Yellow Pine," but whether the attempt will be successful, is another question. In low, sandy places it would pay to make a trial, but its culture on a large scale, may prove a means of wasting money, as to knowledge, we have had no experience with it upon our western prairies. Still, as it sends a top root to considerable depth, it may grow well there. As we have heretofore stated, its timber is in the greatest demand, for which reason we should adopt all possible means for cultivating it, and if it is transplanted from the seed-bed at the age of two years, and three plants set in each place, I am confident of success.

European Yellow Pine. This depends for its value more than most trees, upon the condition of the place in which it grows, and upon its age, when put to use. It blossoms in May and the seed ripens in eighteen months thereafter, in the month of October, dropping from the cones the following spring. While picking off the ripening cones in winter, we frequently find three different kinds; the ripe ones, the young ones just developing, which will be matured by the following October, and lastly, the old ones, which have shed their seed and closed again.

The process of procuring the seed is the same as with the Norway Spruce, &c. Instructions relating to its cultivation will be given further on.

Black Austrian Pine. Upon the Austrian Pine the needles are from three to five inches long, and cones from two to three inches long. In other respects it is the same as the species just mentioned.

The Weymouth, or White Pine. (Needles, five in one sheath, cones, spindle shaped.) Should be treated like the Yellow Pine.

European Larch. This is a summer green tree, but it belongs to the Conifers. It is the tree for the mountain regions, and will grow at an altitude as high as the Norway Spruce. It flourishes on the heights of the Alps, and in the northern part of Russia is found in greater abundance than other trees. It is now cultivated in all parts of Germany, either in forests by itself, or sprinkled among Spruce, Yellow Pine and Birch. It not only grows on mountains, whose sunny side it likes the best, but notably in almost any situation, except upon heavy clay or wet soils. But it prefers a deep, fresh and rich sandy loam and lime-stone formation. As the wood is soft and spongy when young, exposure to heavy winds causes it to grow crooked, and it is therefore best to mix with pine trees on low, or level ground, or with spruce on mountains or high hills.

The seed ripens in October and November, but the cones should not be gathered until February, as it drops from them better if picked late. Two kinds of cones are found upon the tree; those of a weather-beaten, gray color, being the old ones of last year, from which the seed has been emptied. As the resin, adhering to the cones, melts when exposed to high temperatures and thus renders it impossible for them to open and allow the shedding of the seed, we must expose them to a medium temperature until such time as they are fully opened, after which a good shaking is required before the seed is released. Good seed is dear, and in no case will more than 50 per cent. of it germinate.

The timber of the Larch differs, according to the situation in which it grows, that from mountains, and from trees growing singly, being the best and hardest. In this latter case it differs essentially from the Spruce, whose wood is hardest when growing in dense forests.

Red, and White Cedar. Of these two varieties the Red Cedar is the most valuable, and wherever possible, and the soil suitable should be raised and nursed. It prefers a stony, but rich soil near the banks of rivers, but will grow, even if slowly, upon hills and in different soils, especially when mixed with other trees of equal growth. Under ordinary circumstances it is found of a height of from sixty to eighty feet, and of a diameter of from two to three feet. It grows quite slowly on poor soils, but on such as are well adapted to it, with considerable rapidity, while it lives and remains sound to a great age.

The White Cedar requires for its growth, nearly the same kinds of soil as the Red; still, it will thrive in marshes, if they have originated by springs. It does well, also, upon hillocks which are quite dry. If the ground around either species just named, is loosened up, to receive the seed we can take an abundance of young plants from the natural growth for

further transplanting without any additional expense. During the fall, or autumn the Robins will eat a large amount of seed, and while so doing will let enough drop to seed the places under each tree with half digested seeds eaten before at other places.

The Common or White Cedar does not attain any great dimensions, and is mainly used when large enough for fence posts and railroad ties.

The preparation of the soil for forest trees is different in places, where trees have been already grown and have been lately harvested than in an entirely unbroken prairie, as in the first case, it is only necessary to make the holes during the summer and plant in the following spring; while in the second case, the sod should be turned during the fore part of summer and cross plowed and sub-soil plowed in the following spring and a crop raised upon it (potatoes or a like crop preferred.) If potatoes have been raised no plowing in the spring is required as a harrow will smooth the land well enough for the planting of the young plants of forest trees.

If Spruce is to become the leading timber, it becomes necessary to plant some hardy, deciduous trees between the former, for shelter and protection of the Spruce, which can be cut back when shading too much, and finally when the Spruce needs all the room and protects itself the deciduous trees can be cut off altogether. In case the Spruce is a fauilre, the deciduous trees can remain and form the forest. If the plants are four feet apart each way and every alternate plant is a Spruce, we have the choice above mentioned.

CHAPTER XIV.

MIXED FORESTS.

The trees of which mention has been made in Chapter XIII are only a small percentage of the many kinds which flourish in this country, but the others are only to be found in limited sections.

For the prairie states they will be sufficient to answer all purposes, and even if the first attempt to cultivate them be failures, the people should not become discouraged. Planting trees on the prairie where they are exposed to so many unfavorable and damagaing influences, is a task, the accomplishment of which requires skill and also the means for doing the work in a manner which shall assure success from the beginning. Besides the power to meet disappointments with courage is requisite, together with a determination to persevere until suceess shall finally be attained.

Experience is the mother of wisdom.

It must be conceded that most farmers who come to the prairie and take up land on tree claims have neither experience in the culture of trees, nor even theoretical knowledge of how to plant them. It is no wonder then if failure is the result, and as a natural consequence disappointment, followed by a neglect of tree planting and breaking of the contract which has been made with the government.

The idea of so many tree planters that trees will accommodate themselves to the soil instead of selecting those kinds for which land and situation are suited, quite often leads to failure.

For home use the raising of various kinds of timber is without doubt desirable as well as profitable to the farmer, as he can obtain from his own land any kind of timber which he may need. In planting he may take such species as will come to maturity at nearly the same age, or else those from which he may derive a benefit by cutting them down to thin out his grove in the course of its growth, so that the remaining trees may not be over-

crowded. In the beginning he must plant so that some trees of each sort may remain at maturity, or so that while some kinds have disappeared during the growth of the grove, the species preferred may remainat the end. Set out the plants four feet apart each way, and in time as they become crowded every alternate row, and in the remaining rows take every second tree, so that they are seperated from each other by a space of eight feet on all sides. The first planting must be done in such a way that the most valuable species shall remain after the rest have been cut down. In doing this work we must always bear in mind that all kinds of trees are not fitted to grow in the same forest together, but only such as attain nearly the same size and arrive at maturity at nearly the same age.

The following will do well together:—

White Oak and Red Beech. Maple, Ash, Elm and White Beech, (hop-hornbeam.) Norway Spruce and White Fir or Spruce. Yellow Pine and European Larch. Yellow Pine and Norway Spuce. Norway Spruce and Larch, &c.

It is much better to have forests composed of several kinds of trees as are suited to grow together than to have them made up of but one species, because different kinds draw their nourishment from different substances and places, one deeper from the earth and another from near the surface. It is therefore evident that more trees will flourish upon a given area of land, when so mixed, than when all take their sustainance from the same layer of the soil.

In the planting of trees in places which they have in the future to occupy, the advise to the farmer is, not to undertake too much at one time. It is better to do well and thoroughly what is done, than to fail of success by overdoing. The planting of five acres in the beginning is a great task for one season.

Taking for granted that the soil intended for the purpose has been cultivated at least the year before and that if possible potatoes have been raised upon it, we can begin tree planting in the Spring as soon as the frost leaves the ground and the ground is dry enough to be worked without packing or sticking.

The commencement should be made on that side of the designated piece of land which, when the forest shall have grown, will be the most protected from the prevailing winds. Having provided ourselves with a gardenline and a spade we may go out to our work. To save repeated and unnecessary measurements we should have attached to the line at proper intervals strips of red flannel or other material which will show plainly, to mark the places for the trees in the rows when it is stretched out. It is advisable that the marks be at a distance of two feet from each other, and that the rows be set four feet apart. The rows should run from East to

West, or if the ground is hilly, with the hill. Having taken a number of plants from the nursery, by undermining the roots, so as not to injure them in the least, and put them into a vessel filled with water, which is thinly mixed with loam, the planting may commence.

There are several reasons why it is better to set the plants at as small a distance apart as two feet in the rows. In case some should die enough will be left to fill the space, or if several in succession fail, others can be taken from the place where all grew originally, with a ball of earth, so as not to disturb the roots, and the vacant places supplied. But should all the plants grow, it is an easy matter to transplant during the second spring, those which are not needed to the adjacent land and thereby enlarge the grove without the necessity of bringing any from a greater distance, even if they are obtainable.

The planting of small plants. At each mark press the spade into the earth to nearly the full length of the blade and bend it forward and backward, then cross the cut, and driving it into the ground, bend it as before. Let an attendant then hold the plant in the opening thus made, to the depth at which it stood in the nursery, or one inch deeper, pull out the spade and bring the soil to the plant with the foot, trampling it down with enough pressure to fasten the roots to the bottom.

The planting, especially with Evergreens, can be done in another way. The soil may be loosened with an auger, similar to a post-auger, and in the center of the place, a hole may be made with a sharp stick, into which the roots may be set and filled around with earth. In different localities, trees require different treatment.

Common sense teaches that the way of preparing the soil in the culture of trees on the level prairie must differ from that needful upon mountains, or in low, marshy ground. For, while in high and dry places, the aim must be to retain all the moisture and water gained by rain-falls, exactly the opposite course must be pursued in localities where there is generally too much water. We must also take into account, both the top soil and the sub-soil on the various places, and by these more especially by the latter, be guided as to how to prepare a bed for the plants as well as what sorts to select.

Upon high and dry places it sometimes becomes necessary to raise a crop of otherwise valueless shrubs or trees, which grow easily, and do not depend much upon the soil, in order to create some vegetable matter and protection for the benefit of more valuable trees, which shall follow.

Sumach, Hazel. Blackberry, Birches, vines, etc., all serve as pioneers for better plants. If such a growth is present, it must, in planting trees, be carefully preserved and the plants set between the shrubs, disturbing as little as possible, the original growth; as in such places, without the

shelter and protection derived from it, tree culture would be a failure. It is only needful to give the trees newly planted enough air and to keep them from being smothered by the wild brush.

A naked hill or mountain where the soil is good, should be cultivated by degrees. Starting at the foot it should be plowed around to the extent of the land of which it is desired to make use of. Two furrows being turned against each other, and this process continued, keeping a distance of five feet from one furrow to that of the other, until enough ground has been plowed to accommodate those trees which shall be first planted.

From the fact that the lower part of the hill or mountain contains the best soil and is least exposed to sun and wind, the trees composing this girdle can be of kinds superior to those which will grow on the more elevated portion, and as these trees in a short time will have grown enough to afford some shelter, the process of planting can be carried into the higher regions. As two furrows have been drawn together, holes should be made for the tree plants between the two, or if the nature of the soil will allow, the planting can be done by the aid of the spade in the manner before described.

The plowing should be done in June and the planting in the spring following. If the furrows are made as nearly level as possible, the water will be caught by them and sink into the ground to the roots of the young trees, while the earth which has been thus drawn together, will prevent its quick evaporation. The water will also carry with it to the roots, some of the soluable nourishing substances which are contained in the earth, and the growth of the plants will be promoted.

On hills which are too much exposed to the sun and contain very poor soil, some easy-growing trees may be planted as shelter for the better kinds. But always see if the soil is deep or shallow, and accordingly select the species of trees.

Where stagnant water stands, neither grass or trees be of any value. In many cases an entire, or at least a partial drainage can be accomplished, and the soil improved. But as few species will thrive in a sour soil, we must adopt means to improve it and thus insure success. The following is a good way to proceed:

Starting at the lowest part of the ground, dig a ditch through the middle, after which the places for the trees should be marked out on both sides and a flat hill formed at each from earth taken from this ditch. These hills should be separated by a distance of two and one-half feet in rows five feet apart. The top part of the ditch, or sod, should be laid separately by each hill, for future use.

The above work should be done during the summer and before the ground freezes up in the fall. After the whole swamp has been divided up

in this manner, it is ready for the action of the frost and for planting in the following spring. Spruce plants should be used.

In each hill make an opening quite wide and deep, and place in it the roots of three plants, fill with rich soil, pressing it lightly around them with the fingers, then lay the sods which were deposited at each hill, grass-side down, and if early or late frosts do not injure the plants, a beautiful growth will be the result.

There is sometimes found upon the highest mountains, soil which is as sour as that just mentioned, but from a different cause. For while in the swamps, the acidity proceeds from too great an abundance of standing water; upon the mountains it is caused by a lack of moisture. The remedy is the same as in the first case, but upon the mountains the hills must be made large and covered with stones, and in each hill should be placed five Spruce plants instead of three. But such work is generally too expensive and complicated for the farmer to perform unless he is endowed with extraordinary patience and energy.

Sometimes soil is so stony that there is not enough earth to cover the roots of the plants, and yet fine forests are produced in these very localities, while the land is of no value for anything else. It is not referred to a soil composed of gravel.

In those places, seeding is preferable to planting, as the stones retain moisture beneath themselves and also afford shelter to the young plants or trees. But not to waste seed, it should be put between the stones with the fingers in places where a little good earth can be found, thereby giving to each seed its proper situation and distributing the trees as evenly as when transplanted. Put three to four seeds of Yellow or Scotch pine in a place.

There can be no doubt that newly planted trees derive benefit from the cultivation of the soil around them, but it must be confessed that such a course is impossible where hundreds and thousands of acres are planted in a single year, and therefore the practice is virtually out of the question in the general forests, although it may be done in the nursery.

If the work of transplanting is well done, and only thrifty plants are used, it is sufficient to aid them in their growth during the first and second summer, by cutting the grass and weeds around them, before they run to seeds, and mulching around the foot of the plants with it. Such weeds shelter the plants against the heat of the sun and drying wind, and should not be disturbed, and the material for mulching should be taken at some distance off from the plants. The mulching should be done after a rain, so as to retain the moisture around the trees. The mulching has the effect to keep the ground moist and loose around the trees. If the weeds are allowed to grow, they will cover the ground and give some protection to the roots during the winter and some organic deposits favorable to the trees.

For Evergreens, the seeding of oats or bush beans on the sunny side of the rows is an additional protection rather than the removing of any natural shelter that there already exists.

CHAPTER XV.

DRAINAGE OF FORESTS.

A large portion of the country is covered by so-called swamps and marshes, which in their present condition, are valueless, and there is little prospect that there will be any change. Their origin is mainly due:

1. To their low situation.
2. To a hard sub-soil, through which water cannot pass.
3. To the stopping of the natural drainage by the filling up of the beds of streams and rivers.

As there are many reasons for the existence of swamps, so, many must be the ways of reclaiming them. A survey of the places and the forming of effective plans for remedying the evils are the first requisites.

In forest lands, the digging of ditches is sometimes sufficient to effect a good drainage, without sacrificing any of the aera as unculturable land. In some cases if a number of adjacent property owners would associate themselves together and undertake the drainage of their lands, they might find others at a distance whose land were too dry who would gladly assume a part of the cost entailed in doing the work on account of the benefit their fields would derive by the surplus water. If we have succeeded in draining the water wholly, or in part, from any portion of the land where peet has formed, we must not at once plant trees there, but let the mass settle in quality before doing the work.

Springs sometimes create swamps, even on high plateaus. In such cases, discover the origin of the springs, and by digging ditches with the necessary fall, carry the water away to some convenient point, or if they have their origin within the swamps, cut directly across them and thus effect a drainage. In this way an opportunity is afforded of watering other places which are very dry, and gaining full returns for all which the drainage has cost us.

The soil of a large aera consists of a heavy clay, which cannot be worked until very late in the spring. The ground is too cold for the germination of the seed, or to enable the roots to begin their growth. While time is thus lost and the growing season shortened, there is another difficulty with such soils, when long-lasting drought occurs. Then the soil becomes very hard, and when the water has evaporated, it shrinks; large cracks are formed and the roots of the growing crops are not only cut in pieces, but also exposed to the sun and dry winds. The drainage of such a place, by means of either a stone or tile drain, would remove all such hinderances to the growth of crops. The main point is to allow atmospheric air, (oxygen) to enter the soil and make it more mellow, and consequently, sooner warm and fit for the reception of the seed. If all farms could be managed in accordance with reason and the laws of nature, less complaints would be heard, that the soil of this or that locality was exhausted. There is no exhaustion, but only a need of more painstaking and the exercise of better judgement.

CHAPTER XVI.

THE THINNING OF FORESTS.

Important as it is that young trees should grow close together until they have attained a certain age and size, it is just as necessary to aid them by thinning out when crowded.

There are many reasons why they should at the beginning be closely planted:

1. If every piece of land destitute of good vegetation and forest growth, and exposed to the burning rays of the sun and to atmospheric influences, becomes yearly poorer, it must be our aim to give the young trees planted theruepon the needed cover and protection against these influences. The planting must therefore be done thickly, that the area may quickly receive the necessary shade.

2. Trees closely planted grow in the direction of their height and the lower branches being shaded, will go to decay before their dimensions become such as to spoil the trunk and its future value for timber. But by a judicious thinning out the requisite space should be given to each tree.

In giving to plants the necessary room for their growth, many things must be taken in consideration. To give general rules is difficult as good judgement of the operator is the first and main requisite. In doubtful cases it is better to leave the largest and finest trees and remove the others; but the thinning should not be done to such an extent as to leave spots of ground uncovered and exposed to the sun. To avoid this even some poor trees may be suffered to remain. Neither should any branches be cut from those left standing, not even those that grow very near to the ground, since these are the very ones which keep out the sun and prevent the wind from blowing the leaves away, especially in mountainous regions. The poorer the soil and the more exposed the place is to atmospheric influences, the more careful should the thinning out be performed.

The greater the uniformity existing among trees, the more they need thinning, especially with such as have been planted, particularly with Spruce. The thicker the trees stand the more carfully must the operation of thinning out be conducted. Where heavy snowfalls occur the process should be commenced quite early and good judgement exercised to prevent the breaking down of the tops. The more often the thinning is done the better for the forest. In those places where it is desired to raise timber alone, the trees must be kept the thickest. At or near the edge of the wood they should be left to grow more closely than at other points, hardly any being removed, as otherwise an entrance will be given to the wind to blow off the leaves, and to the sun to burn up the ground. It is much the best to thin out in the summer, when the closing of the tops and branches can be better observed.

Deciduous trees should always be cut close to the ground that they may spread again and add to the shading and fertility of the soil by the leaves of the new shoots.

It may here be mentioned to satisfy those that advocate letting the thinning of young forests to natures care, that nature will perform that duty excellently, and manage it so that a number of the trees would in time make room for themselves and come out of the battle victorious, from the survival of the strongest, but this battle is fought greatly at the expense of the survivors themselves, since under such circumstances their own growth is very much retarded.

CHAPTER XVII.

DAMAGES TO FORESTS.

So long as forests remain in their natural, primeval state, there is no danger of any damage being done them by insect tribes, even if any exist within their boundaries. But as soon as we begin to meddle with them, by cutting down trees, and especially when it becomes needful to replace them by planting, &c., the ravages immediately begin to show.

Damages By Insects. Insects hardly ever attack a thoroughly healthy tree, until they have so increased in numbers, that the sickly specimens cannot furnish them with an adequate supply of food. In a healthy forest, the conditions for their multiplication are not present. In the old forests there is too much shade and moisture and a lack of high temperature favor able for the hatching of the eggs of insects or from their changing from one state of development to another.

The millions of hardly visible holes in spruce and pine logs, as well as those of hardwood trees prove the presence of the most destructive of insects, the borer, (Bostricus) in alarming numbers. During the months of of April and May, as their swarming time, cut down a large number of trees and let them lie upon the ground until after this is over and then peel off the bark. They will in most cases, lay their eggs in these fallen trees and upon peeling off the bark, these, or perhaps the larvae, if already developed, will be exposed to the sun and weather and thus millions of these insects destroyed and hindered from coming to maturity.

The bark should be burned, as some species lay their eggs in it. The larvae which hatch from the eggs continue the work of destruction and in their turn change into chrysalist within the tree, coming out in the following spring as full-fledged insects.

As far as known, each species of tree has insect enemies peculiar to itself, and if all are not as mischiveous as the borer, any of them will do

more or less damage. Some species of borer work between the wood and bark while others go right to the center of the wood, causing young trees to break down,

There is another insect in our forests which does its mischief while in the fully developed state, as a beetle, the "wevil," or "curculio, R." In the cultivation of a young growth of Evergreens, this insect appears, but it drops to the ground upon the least danger which may threaten it. Only tra es of its ravages in the bark of the young trees gnawed off just above the ground can be seen, and the sap oozing from the wounds thus made while the perpetrator of the mischief lies on his back just beneath, indulging himself in the fond belief that he is innocent of having done any harm to the tree. The color of the insect is blackish brown, and therefore it is not easy to detect it as it lies upon the earth. It is about the size of the Colorado beetle, but its body is longer and it has a muzzle, or trunk with which it does its mischief. The only known protection against it, is to lay beside the young plants a little bunch of fresh-broken Spruce branches or bark of the same species as the plants themselves and cover them with sod or stone to keep them in place and shaded. The fresh-smelling resin has more attraction for the beetle than the plants.

There are many species of beetles, some of which eat the bark, and others the leaves of the trees, or their seeds, but the damage they do to the large trees, does not compare with that done to young plants, of which they will kill nearly all if left undisturbed. The immense harm done to the forests of Europe by caterpillars shows plainly what we may expect, unless a close watch is kept constantly, and all rubbish left in the forest, carefully collected and burned, while pieces of woodland, through which fires have run, if they present a sickly appearance, should be entirely removed. Pine forests are much more subject to attacks from insects than those of deciduous trees, and it is therefore best to mix both kinds together in a forest.

Damage by Heavy Frosts. Severe cold or frost is hurtful to most kinds of forest trees and even if its injurious effects are not seen at once, their less rapid growth and shortened lives are some of the evil results which the best of soils cannot prevent. Frosts are particularly damaging after trees begin to renew their growth in the spring. The effect of late or early frosts is mostly felt by the Evergreens, as it takes them longer to form new upright shoots than other trees. The planting of entirely hardy, between the less hardy trees will greatly prevent the injurious effects.

3. Damage by the Sun. The direct rays of the sun are not only dangerous and hurtful to the small seeds just germinating and to the little plants, but also to large trees. If after cutting, the hot sun shines upon the exposed trunks of these which are left, they will become scorched and

blighted, the bark will drop off and much harm be the consequence. To avoid injury being done in this manner, divide the woodlands so that the boundaries of the annual cuts may lead from North to South. Young plants, especially evergreens, must be protected from the sun and from frost by the planting of rapidly growing and hardy plants, which may be cut down after those which they have to protect are able to shelter themselves. Blight takes place on trees forming orchards from the same cause as in others and therefore the planting with them of some hardy forest trees which form large tops, but do not shade them too much are recommendable.

4. Damages by Wind. The different quarters from which winds blow give the forester little opportunity to protect his forests against their damaging influences; he may guard them from injury from the local prevailing winds, but against those which sometimes occur, as thunder storms, hurricanes and cyclones, where the direction from which they may come is uncertain and purely accidental and cannot be determined by any rule protection can hardly be given.

Those species of woods where the roots run near the surface and which do not possess a tap root, such as Spruce, Fir and the like, should never be so exposed to receive the direct force of these winds. To avoid this there should always be planted on the boundries of forests several rows of such trees as drive a good tap root, to break their force to a considerable extent and at least to render the damage much less than it would be without this protection. The recommendation for preserving forests from the attacks of insects by mixing Evergreen with deciduous trees will work well as a preventative against harm being done by heavy winds.

5. Damage by Snow. Young, or middle aged Pine or Spruce forests, especially when too much crowded, suffer mostly from snow. The damage is done by its pressing upon and breaking down their tops and branches. This may be successfully prevented by thinning out the young trees or planting at places where heavy snowfalls are of frequent occurence, so that the branches, being further apart, may not offer to the snow so large an aera upon which to settle.

6. Damages by Water. Damage is done both by standing or stagnant water, and also by running water. Standing water harms the forest by spoiling the soil and rendering it unfit for the growth of trees, making it sour and converting it into swamps, producing by evaporation, low temperature in its vicinity, and occasioning late and early frosts Drainage is the only remedy in such places or filling up, so as to get surface drainage.

Running water does harm in many ways.

1. By washing away the soil and uprooting the trees.

2. By covering the ground with sand and stones during the period of an overflow.

3. By keeping the trees too long under water at such a time and thereby killing them.

4. By freezing over, after a thaw has occasioned it to rise around the trees, and upon falling, leaving ice adhering to them to injure the young wood or perhaps destroy them entirely.

5. By floating ice.

The forester may guard against those evils in the following manner: The banks of rivers must be kept well lined with deciduous trees, which should be cut before their weight becomes too great, as otherwise they will fall into the water doing at the same time great damage by tearing and loosening much soil, and stopping the free flow of the water. Willows and common Alders are the trees best adapted to this purpose. The beds of rivers must be kept unobstructed. All obstacles to the free flow of the water removed, and the crooked places straightened.

Dams must be built in places where caves threaten to stop the water. It must also be borne in mind that places subject to overflow should not be seeded, but planted with trees. Where floating ice is liable to do damage it is advisable to leave some wood standing a few rods from the banks to keep it within narrow limits. In these places only cut down the larger trees and leave the smallest standing.

CHAPTER XVIII.

ROTATION OF SPECIES IN FORESTS.

Wet and dry places, high mountains and level prairies, cold and warm climates and the difference in soil, furnish conditions under which certain species of plants thrive best, and for this reason often distinct and sharp lines between territories are abounding with certain kinds of trees. It is therefore the task of the forester to give to each tree its proper place, thus following the example set by nature in its distribution of sylvan growth.

Agriculture and horticulture both teach us that crops of the same kind cannot be profitably raised upon the same land during successive seasons, and long ago the rule was adopted by the practical gardner not to plant the same varieties in the same places two years in succession. In the same way we find that notwithstanding, the best of care may be given to the existing kinds of trees, they will after a time, begin to lose their vigor, while new species springing up among them will do well. This change is usually from deciduous trees to Evergreens, or the reverse.

It must be considered as a hint of nature that a rotation or change from one species to some other is a necessity and as profitable in the case of the forest as that of the cultivated field. With the forests, the periods between the making of such changes are long in proportion as the time before trees arrive at maturity is long, as compared with that between the planting and ripening of field crops. The length of time before the change is necessary, does not in the least degree prove the falsity that after a time—it may be after the lapse or many generations—a change of species is required.

It has been noted in France, that a forest reproduces itself with a different growth within four hundred years. In our own country, it is seen that, where Pines and Spruces are cut down, their places are taken by deciduous trees, but as to how far the necessity exists for a change is not thereby certainly proven, but still it is quite certain that this is a signal given by nature as to what should be done.

CHAPTER XIX.

THE HARVEST.

The farmer harvests his field crops when ripe and is not in doubt in regard to the proper time, but in the case of the forests it is neither so easy to determine when the right time has arrived, nor at what time it is the most profitable to cut down our wood or timber for the market.

The time for harvesting forest trees is when their annual growth or gain reaches the average growth or material gain. For example, suppose the last years growth has been $1\frac{1}{2}$ cubic feet per tree and the whole tree measures 50 cubic feet at the age of fifty years, it is plain that the last years growth was far above the average yearly growth, and that to cut that forest down would entail a great loss. It may be further said that if the average and the annual growth are equal it is better to wait a few years before harvesting, or so long as the annual growth may come up to the average.

The next point as to when to cut the forest is the requirements and conditions of the markets. If logs of a certain dimension are required, for which a much higher price is offered per cubic foot than for those of less size, it may be expedient to allow the trees to remain standing until they arrive at the required dimension, even if their yearly increase is a little below the average growth they attained in the past, since the higher prices received for the timber will more than compensate for the loss of gain in growth. Observing the growth of the forest from year to year it is easy to find the yearly gain of trees above or below the average. A very sure sign of maturity is that the tree tops are beginning to round off and the foliage to grow thin. An experienced forester can determine whether a forest has reached maturity at a distance from it of five miles:

To discover the annual growth of a tree without first cutting it down is a matter which requires skill and mathematical knowledge. It may how-

ever be determined in the following manner: Cut with a chisel from the tree a portion of the wood, leaving the place cut in the shape of a right angled triangle, sitting upon its base. Upon further smoothing base with the chisel, count and measure the rings annually formed around the axis of the tree. The thickness of these will show whether the yearly growth is increasing or deminishing, and from this knowledge in regard to single trees especially if selected from an acre several of average size and make the cuts on both sides of them, at the same time counting the trees on the acre, learn the annual increse of material on each acre. It can be easily seen that these measurements cannot be made by a carpenters scale; to do the work properly a magnifying glass is required. Care must be taken not to get deceived in regard to the annual growth by the sometimes indistinct boundaries of the rings. The formation of these rings yearly may be thus explained: (The well known fact that the annual growth takes place between the bark and the growth of former years, and that the bark also has a yearly growth has no moment in the explanation.)

In Spring the warmth of the sun awakens the tree to new life, the sap rises and consequently vegetation is more rapid than at any other period of the year. The sap flowing through the tree and mingling with the reserve of nourishing material secreted in the pores during the last years growth to give it a fresh start before the leaves have formed, causes the rapid forming of new cells adjoining those formed during the last autumn. These owing to its more rapid growth are larger and more porous than those formed at that period. The wood therefore must show a difference in texture on the limits of each years growth, and hence the amount of gain is easily seen. But sometimes at the end of July or the beginning of August the rising sap takes another lively start, causing another more rapid growth to the tree and forming other cells out of proportion with those formed either in the Spring or in the latter part of the year, and which may by the inexperienced be taken as another annual limit. On this account a careful scrutiny is required to prevent any mistake being made. It may also happen that drought may set in and stop all growth after which drenching rain may give a new start to vegetation. But this can eesily be determined in the annual rings.

CHAPTER XX.

THE FUTURE OF THE SOUTHERN FORESTS.

On the question: "How long the great forests of the South, more especially the most valuable portion, the long-lived pine, last?" the authorities differ. Recent writers estimate that at the present rate of consumption, the Pine supply in Texas will last 250 years; in Louisana, 100 years; in Mississippi, 150 years; in Alabama, 90 years; in Georgia, 80 years; in Florida, 30 years; in Arkansas, 300 years, and in South Carolina, 50 years.

Dr. Mohr estimates that in 1880, 200,000,000 feet of lumber found outlet at Pensacola, 60,000,000 feet at Moline; 60,000,000 feed at Tascagaula; 13,000,000 at New Orleans; 36,000,000 feet from Pearl River at Bay St. Louis; 12,000,000 feet by the New Orleans & Chicago railroad and 12,000,000 feet by the Louisville & Nashville railroad. This lumber came from the states of Forida, Mississlppi, Alabama, and involved the depletion of a little over 200 square miles of forests in a single year.

In every state in the South, State Forestry associations should be organized. These would serve the purpose of similar societies in the Northern states in encouraging the growth and preservation of forest trees, with the additional advantage of advertising the forest resources of the south.

CHAPTER XXI.

PRUNNING OF TREES.

Trees, in their natural and undisturbed state which have full room for growth, the proportion between roots and branches is well balanced and developed, but in taking one up, however careful the work may be done, this proportion is more or less changed, and generally confined more to the roots than the branches. It then becomes necessary to restore them. In prunning a tree, keep the sun from shining upon the roots, inspect them and compare them with the branches, and observe how much they have been broken or torn, proceed to cut off all upon which any wounds or bruises are found in the sound wood above the injured part. The cut must be made sloping and on the under side of the wood, so that it cannot be seen, when the tree is set upright, and will sit directly upon the soil after the tree is planted. The slanting or sloping cut gives more area to the formation of callous, out of which the roots develop. As the callous forms between the bark and wood and the roots grow right out of that into the ground, they would have to grow upwards first, if the cut was on the upper side of the root, and then turn and take their natural downward course.

In prunning roots as well as tops or branches, be very careful not to loosen the bark, since if this is done, no callous can form, and of the branches, a portion will die. If any cut is made with the saw, immediately smooth it with the knife, always cutting from the back toward the center, or axis of the root or branch.

Small, young trees need no prunning of either roots or tops, except of such as have a tap root and which are intended to set out as soon as they have reached the required size. After several transplantings to the nursery cut off this root when they are two or three years old, to make the final planting more easily, which, were this not done, could only be accomplish-

ed with the greatest difficulty. Such trees will aferwards send their roots deep into the earth, to take the place of the missing top root and continue to grow well. To this species belong the Oak, Hickory, etc., and if these are transplanted while very young, the top root need not be disturbed.

In prunning always cut the branches so that there may be left a sleeping butt, which can easily be detected, to replace the branch removed. Reference must also be had to the position of the bud, that the branch growing from it may take such a direction as to improve the form of the tree. Of all branches which cross or injure each other, the inferior must be removed, and in cases where two of equal size, growing from a third main branch are crossing each other, cut off that which will injure the shape of the crown the least by its removal. After once beginning to prune in this manner, a person having a good eye and good judgement will soon learn to distinguish detects in the shape and how to remedy them.

If a tree has two leaders which form a fork, cut off the inferior to avoid the splitting of the tree in future. Never let suckers grow up from the bottom of the tree, which injures or kills the tree.

In this way we may cut off two-thirds of the branches and still preserve the original shape of the crown, which should be our chief aim.

CHAPTER XXII.

PLANTING OF TREES IN CITIES.

The observer of American Cities and Villages will notice the good taste which many of our citizens possess in decorating the streets and avenues with ornamental and shade trees, and in surrounding their residences with emerald green turf and beautiful flowers. In fact within the limits of some cities are portions which more resemble a park than a city, and if any complaint is to be made or fault found, it is that there is in many cases, if anything too much shade and the trees too much crowded to permit their development to masterpieces of nature.

It is true that although many thousands of trees are planted every year the work is too often done by incompetent persons, or those having it done are careless or not able at the proper time for planting to find those who are competent to perform it. People also often expect to get good trees for half the money which they are worth, or even if they do obtain good sound trees and plant them at the right time and in the proper manner, take such miserable care of them that they shortly die.

To plant and raise trees successfully requires knowledge and practical experience, the same as any other business, and as shade trees are already growing to some extent along the streets and avenues of nearly all our cities and villages, it is an easy matter to tell what species to make use of for additional planting in these places, as the selection should be made from those which are doing the best in neighboring localities. In making the selection of a kind for a certain street or avenue, take such as are growing upon it, as nothing gives a more beautiful aspect to the street than rows of trees on both sides, uniform in appearance. In case there are no trees to serve as a guide, the following species may be chosen as being the hardiest and best fitted for any place when well cared for.

American Linden, American and European White Elm, Ash, White

and Yellow, Hard Maple, Norway and Soft Maple, Box Elder and Hackberry. These trees are the only kinds to use in cold climates, for the purpose of lining streets and avenues. If forced to draw our supply from the wild woods or forests, our aim must be to select young trees which will answer to the following points.

1. No tree should be selected which has been oppressed or much shaded by the others.

2. No tree which has equal thickness at the bottom and first branches.

3. The top must be proportioned to the thickness of the trunk.

4. In heavy clay soil, grown trees have few small roots and should be avoided if possible.

5. Trees with moss on their trunks and branches are suspicions and should find no grace in the eyes of the selector.

6. Also should trees with two equal thick tops be looked upon as unfit for our purpose.

But trees with a healthy appearance, well proportioned from bottom to top and a uniform annual growth, are good trees to select, and if by taking them up, the roots are proportioned to the tops and the size of the tree, they are worthy of painstaking with them.

For warmer climates and the eastern states, select Silver Maple, Buckeye or common Chestnut, Honey Locust, Magnolia or Cucumber and Umbrella tree, Sycamore or Button Ball and the Catalpa or Indian Bean.

All these will not flourish in the same soils, but the preferences of the most important have already been explained in the preceding pages.

Trees with a healthy appearance, well proportioned from bottom to top and showing a good uniform annual growth, are the proper kinds to select. Trees so chosen should be removed from their places with the utmost care and the exercise of the best of judgment. The digging around the roots should be done at such a distance from the tree as to be beyond their ends, so that after prunning they may be left unbruised and without wounds. A ball of earth should be left around them and the whole tree or ball undermined. To get this seperated from the roots, bend the tree from one side to the other, so as to press it off and clear away such as is then left, with the hands. To get rid of it in this way, drive into the ball, perpendicularly, sharp, wooden stakes and pull them forward from the tree, thereby taking away the earth without injuring the roots, as this will give way before the stakes, and the stakes will break sooner than the roots. In transplanting trees from a long distance, it is best to have all, or nearly all the earth removed, as otherwise its weight resting on the bottom of the wagon may cause the breaking of the roots.

Avoid the bruising of the bark, which will do a great, though perhaps

not visible injury, to the tree. In moving trees upon a wagon, arrange their roots well, filling in between and around them with earth until they are covered, and if it is practicable, setting them upright and covering the roots. This will prevent friction of the trunks with the wagon.

The digging of the holes depends upon the quality of the soil. The poorer it is the larger and deeper they must be dug, and when it does not interfere with travel, they should be made in the previous autumn, so as to admit of the favorable action of the frost upon the excavated soil. For a tree two or three inches in diameter, a hole six feet in diameter and two feet deep is required, and in very poor soil it is better to make the diameter eight feet. If the earth taken out is not to be used again in the planting, we must haul in, wherever the holes are six feet in diameter, two and one-tenth cubic yards, and when eight feet, three and three-fourths cubic yards for each. As the space between the sidewalk and the street proper, is, in cities, not of sufficient width to allow of the above given diameter, make the length of the hole greater than the width, resting assured that the roots will always grow in the direction of the good soil.

CHAPTER XXIII.

PLANTING OF LARGE TREES AND TRANSPLANTING.

Planting of trees, if carlessly done, all our previous painstaking has been in vain. In doing this work, three persons are required; one to hold the tree, one to shovel in the soil, and the third to do the planting itself. After filling the hole to the proper height with good soil, causing a little hill in the center as a stool for the tree, set it upon this so as not to be hollow under the trunk after planted. While one man is holding the tree the planter takes hold of the roots, and being supplied by the third man with fine soil, places each seperately, according to its natural situation and place of growth, the lowest at the bottom and the highest at the top, thereby dividing and distributing them over the whole place around the trunk, taking good care of the fibre rootlets, packing the earth around each and pushing the earth under the trunk, to make sure no hollow is left there.

Great care must be taken during this process to keep the tree in a verticle position, as bending it to either side, when once planted, will move the roots from their proper place. After the planting is completed, the tops of the on et, or place where the roots start from the trunk, should be exactly on a level with the surrounding earth, while the level of the earth around the tree, should be one inch below the level of the original surface. Some people having the idea that if a tree is set deep, it has a better chance for receiving moisture and is less subject to drought in summer, plant from one to two feet too low. Where this is done, the trees will die of suffocation. The roots of a tree need air as well as the branches, and in order to start new ones, the soil around requires a degree of temperature fifteen degrees higher than that of the atmospheric air. Besides, a tree needs such mineral substances as are soluble in water, and how can the chemical process, which turns mineral matter into such a state as to render it easily digestable by the roots, take place at a depth at which the atmos-

pheric air with its oxygen, has no entrance?

All deciduous trees, when planted too deep, will, if they survive at all, form new roots near the surface of the ground, while the old ones will either die or cease to perform their alloted functions. Better plant trees near the surface and even if some species require that certain sets of roots should grow to a greater depth, a growth downward will be much easier than one upward, which they would be compelled to make in order to get air, if set too deeply.

If all the rules given for the transplanting of trees have been strictly followed. we may be assured of success, and if we had the control of atmospheric and meteoroligical influences in the same degree as of the planting, our work would end at this point. But under existing circumstances we must aid them in their growth by watering in dry weather once or twice a week, and putting around them straw, manure, &c. as mulching. This mulching should be about 8 or 9 inches in thickness and extended over the roots of the trees.

TRANSPLANTING OF LARGE TREES.

If there are any fine large trees which shall not remain in their present position much longer, and which are to be transplanted rather than cut down for firewood, having at least a years time in which to do the work, proceed as follows: Early in the Spring dig a ditch two feet wide at a distance of two or three feet from the tree, according to its size, and extending in depth to the bottom roots, which must be cut off with an axe. This must afterwards be refilled with earth and as many branches cut from the top of the tree as can be without injuring its shape, after which it must be left standing at least until the next fall, to allow those parts of the roots which have been cut to send out rootlets by the thousand, which will after it is transplanted abundantly supply the tree with sap. If the part which was dug as a ditch in the spring be in the fall heavily covered with manure and a hole made at the new place for the tree, and the earth taken from it also covered in the same manner, it can be taken up and set there in the winter with a frozen ball of earth around its roots.

CHAPTER XXIV.

RAILROADS AS TIMBER CONSUMERS.

In the report on forestry, Volume IV, 1884, Nathaniel H. Egleston said about the use of timber for railroad purposes as stated by correspondents:

"During the years 1881 and 1882 our railroad system was greatly extended. Poor's railroad manual gives the total mileage of track on the 1st of January, 1883, as 138,901.66. At the same rate of increase the amount of track now in use would vary but little from 150,000 miles. If we adopt this estimate it will show a greatly increased demand upon our forests for the purpose of railroad construction, beyond that indicated by the returns given in the report. It will show that for the construction of our existing roads we have used 396,000,000 ties, or the wood supplied by 3,960,000 acres, or an area larger than that of the states of Rhode Island and Connecticut. Estimated that ties need be renewed on an average once in seven years, there must be drawn from the forests annually, in order to keep the existing roads in repair, 56,571,428 ties, or the timber growing on 565,714 acres. Allowing that a growth of thirty years is necessary to produce trees of proper dimensions for ties it will require 16,971,420 acres of woodland to be kept constantly growing as a kind of railroad reserve, in order to supply the annual needs of the existing roads. This constitutes an area considerable larger than the state of West Virginia and larger than the states of New Hampshire, Vermont and Massachusetts combined, or the states of New Jersey, Maryland and Deleware with the addition of Connecticut. It is more than 4 per cent. of the total area of woodland in the United States exclusive of the Territories and 3 per cent. of the area in the States and Territories together."

This shows the case of the present and the past. But there is another view. The increase of railroad mileage in the United States from 1873 to

1882, both inclusive was 48,879 miles or an average annual increase of 4,887.9 miles. Taking the twenty years from 1863 to 1883 the average increase is 4,150 miles per annum. Estimating the yearly increase from January 1, 1883 to be the same for the last twenty years, there would be an addition of 41,500 miles in ten years to the 138,901 miles existing at that period making a grand total of 180,401 miles. To construct these additional miles will require 10,956,000 ties annually or for the ten years 109,560,000, the product of 1,095,600 acres of woodland. Allowing thirty years as the period of growth for ties, this would add 3,286,800 acres to the timber reserve needful to keep up the existing roads, or a total of 18,995,570 acres. If the calculations were extended to thirty instead of ten years for the construction of new lines, then the reserve of woodland necessary to keep the existing roads in repair would be not less than 25,950,356 acres. These figures show in an impressive light the large and rapidly increasing demands which are made upon our forests from one source alone.

CHAPTER XXV.

DUTY OF THE GOVERNMENT.

[By E. T. Baker, U. S. Forestry Agent.]

"One of the questions propounded by the Department is, 'What should the Government do for the preservation and increase of the forests on the public domain?' To this question it may be replied that the first thing the Government should do, is to consider its forest domain as separate and apart from every other. The rules and regulations which apply to the prairie should not be made to govern the sale &c., of the timber lands. The extent of the forests still belonging to the United States should be ascertained and considered separately.

"To begin with, the Government should stop the wholesale spoliation of these lands by private individuals or corporations, and whatever the means necessary to this end, should be applied promptly. The Government should, as a rule, withdraw its timber lands from sale or occupancy. To sell them does not promote the settlement of the country; it only enables some individual to obtain for his own benefit timber at less than its value. The Government should make the custody and care of its forest domain the particular charge of officers who regard the interests of the Government. These officers should have regular stations and prescribed districts of country assigned them, not mere roving Commissioners. The Government should impose necessary regulations to prevent the wholesale destruction of its forests by fire. This should be done by the general Government to protect and preserve its own property. Further than this, the general Government should encourage the increase of the tree area in this country. It should do this by first disseminating information. It has been shown, that the present agencies at work are not sufficient. The Government should supply the people, to some extent at least, with instruction on the great subject. It should be furnished in the shape of reports and other printed

matter, issued at frequent intervals in convenient form, free from discussions remote from the points at issue before the people, and free from technical terms unintelligible to the masses.

The Government should establish collections, accessible to the people, of the woods of the United States. These collections can be best made under the directions of the Government, and they should not be kept at Washington exclusively, but at as many different points as possible. The agricultural colleges in the various states would be suitable depositories and where States maintain agricultural departments, the offices and rooms of such departments. Finally, the Government should make it understood that forestry and its ally, irregation, are interests which are to be fostered in common with the general interest of commerce and agriculture.

In conclusion I submit, as evincing the interest our neighbors of the Dominion of Canada feel in the question of forest-preservation and as containing ideas of value, the following extracts from a Canadian gentleman:

"A little more than one hundred and fifty years ago Europe was awakened to the fact, that her timber supply was being gradually exhausted; the forests were either in private, municipal, or ecclesiastical hands, or so saddled with private rights that the states had no adequate control of them.

The consequences apparent were exploitation of miniature timber, to the serious depreciation of the yield; the consequent want of first-class timber for ship building and other important works; the destruction of seedling trees by cattle, resulting in a scanty crop of low bushy trees. In a word, the area was being gradually contracted and the annual yield reduced so much by mismanagement and neglect that it fell below the annual consumption; capital stock was being strengthened on a condition under which the utter exhaustion becomes a mere question of time.

Austria, Germany and France rose to the emergency; they extinguished private rights, introduced state control and demarcated the areas to be maintained as permanent forests. Germany reserved a third of her total area as forests. Austria a triffle less. And France nearly a fourth. Their aim was to increase the timber production to the highest capacity of the reserved area, and to limit annual exploitation to annual increment.

Forest management in all these countries is now a great state of industry, scientifically conducted. It is under the control of a specially trained department. The remedial measures exercised an important bearing on the well being of the countries named and what is more to the purpose, the undertaking has proved remunerative. The timber and other forest products yield a revenue leaving a margin of profit on all costs, including rent of the land.

In America, both the States of the Union and Provinces of the Dominion have already passed the stage at which remedial measures were intro-

duced in Europe, our population is growing at a rate unparalleled in the past, and secondly, because the whole interior of the North American continent depends now, and must continue to depend upon the Atlantic and Pacific states for the great bulk of its timber.

The saddest feature in the American timber problem is that the people have not yet shaken off the old tradition that, "timber land is worth the value of the land, less the cost of clearing." The stock of American timber is now so reduced, that if artificial causes were not at work, to keep down prices, there is not an acre of timber land on the North American continent that could not be sold for the amount which it would cost to reproduce it.

These artificial causes referred to are on the surface. England, with her wealth of iron and coal, favored by her insular position and large foreign trade, did not trouble herself about growing timber, as long as she could supply herself from the supposed inexhaustible supplies of northern Europe, cheaper than she could grow it. She consequently supplied herself from Sweden and Norway, which possessed large natural forests, costing nothing. Europe was a first-rate customer to these countries and in due course North America began to compete for a share of the trade, the market was overstocked and prices fell to the narrowest possible margin on cost of bringing the timber to market.

In the struggle, Sweden and Norway have damaged their natural forests, and are now organizing measures for restoring them at about three times the price at which they sold their natural crop. As a consequence, America has the monopoly of the English trade, an enormous home demand is being rapidly developed, and her stocks are undergoing such rapid exhaustion that, with holding supplies, she could command prices undreamed of by the most visionary. But in the face of these facts, the government of the United States and the Dominion, have the control of private parties who, in spirit of competition, go on flooding the markets to their own and the national detriment.

Good Pine timber requires a century for its development. There is as much timber now growing on the American continent as, with proper management and restriction of exploitation to ascertain annual increment, would avert a severe timber famine. But if the problem is not soon grappled with, America will ere long be dependent on Europe for her timber supplies.

The position is too critical for temporizing or half measures. The difficulty can only be met by the resumption by the State of untrammeled control of its remaining forests. This is an heroic measure, but nothing less would save the country. It would be costly, but the most pecuniarily profitable investment the state ever ventured on. The problem is so grave

as to demand the most careful consideration of the ablest advisers of the union and dominion government and much would be gained, if the two would operate harmoniously on a prearranged basis.

If the programme I have suggested were adopted conjointly by the union and dominion governments, existing stocks held back and felling stopped for three years, to work of private stocks and let the demand make itself felt, prices would go up with a bound and I do not think they would stop far short of $200 per mile, American quotations.

At such rates the remaining forests, instead of hastening to extinction, would be permanently revenue producing, besides yielding a fund to meet the costs of a measure of forest administration commensurate with the future requirements of the continent.

CHAPTER XXVI.

The following paper read by the author before the convention of the Wisconsin State Agricultural Society, in Madison, held in February, 1881, will prove that he kept a watchful eye upon the subject at all times; it reads as follows:

THE TASK BEFORE THE AGRICULTURAL SOCIETIES OF THE COUNTRY IN THE NEAR FUTURE.

No one will deny the influence of our Agricultural Societies in the good results realized from the farms of the country, but we cannot help admitting that one branch necessary to successful farming as well as to health and prosperity of the country has been so far sadly neglected, and this is the forests of the country.

We are aware that the National Agricultural Department in Washington has made several efforts to have the government take the preservation and restoration of the forests in hand, and that the Secretary of the Interior authorized by Congress, has adopted some means to prevent the cutting down of the forests in the territories. But all this is not sufficient for the preservation of that extent of forests which is needed for agricultural and manufacturing purposes.

The forests should cover from one quarter to one third of the area of a country if that country is to be healthy and fitted to fulfil the conditions under which agriculture may be carried on with success.

And not only is the extent of the forests to be considered. We must also take into account their proper distribution over the face of the country if we would secure the utmost possible benefit to its inhabitants. The shelter and the humid healthful atmosphere of the forests in the far western territories have no effect upon the inhabitants of Wisconsin or New York.

As the time between the planting and harvesting of forest trees is be-

tween eighty years for Pine and from two to three hundred years for white Oak trees, it is of great importance to select for arboriculture those soils of the country where no other crops could possibly be produced, and limit the cost of first planting to the lowest possible figures.

When we consider that some soils are in reality not fit for agriculture and have to be termed on the assessors list and on the maps as unculturable land, would it not be a welcome sight to see young forests springing up in such places, and though growing slowly, benefitting the surrounding agricultural districts with a humid atmosphere, shelter against high winds, and against changes of temperature, frequently so sudden and so disastrous?

In Europe the various governments have found it necessary to make the care of forests a particular subject of consideration and legislation, and have created special bureaus under the management of competent men, who had to serve a long apprenticeship, graduate in the art and science of forest culture, and who have made the forests a source of revenue to the government amounting to millions of dollars from the poorest soil of that country. While the direct net income of these forests is counted by millions, their influence upon health and agriculture can not be estimated. And when we consider the rapid increase of population in our own country, the wants and requirements already made upon the forests, and the present comparitive scarcity of timber, it is easy to see that here also similar measures will soon have to be adopted.

It will perhaps be objected that in the vast area of these states the millions of acres of woodland still remaining will be sufficient for all the wants of the country for years to come. But it must be remembered:—

1. That this abundance of wood is found just in those parts of the country where it is least needed, and that in consequence of the expense to bring so bulky an article as timber to the centres of demand, it is comparatively valueless where produced and is for the most part left to fall before the axe of the settler.

2. That two-thirds of the timber left to us is of such quality as to be only fit for fuel.

3. That in the census and tax statement a large area is classed as woods without deserving this classification.

4. That Chicago alone employes a capital of $80,000,000 in the lumber trade and that hundreds of thousands of acres of timber are annually sacrificed.

5. That Michigan and Wisconsin, the main pine timber states, which had ten million acres of the finest timber before the main settlement began have only about two million acres left, and this at the present rate will be cut down in about five years.

6. That according to the census of 1860 the value of the lumber improvement in the United States was $3,322,520,000. All this had been cut from the soil and most of it within thirty years previous, and nothing has been done to replace it.

7. That there are five hundred thousand artisans in wood in this country and if we estimate the value of their labor at $1,000 each per annum, we have an aggregate of $500,000,000 worth of wood annually consumed as raw material for their use.

8. That it takes one and one-third acres on the average to produce one cord of wood yearly.

9. That it takes three hundred acres for the production of wood sufficient to build and keep up one mile of railroad year by year.

10. That the United States sends $11,000,000 per annum to Canada for timber, while millions of acres of land capable of producing the finest timber are laying waste in our own country.

11. That the farmer from year to year cuts down vast forests to enlarge his fields, and only saves what will suffice for his domestic uses and seldom that.

12. That the population of the country is daily increasing, the wood consuming industries are developed year by year to larger dimensions, and hundreds of miles of new railroads are added annually to those already in operation, and in general, that while the wood producing area has been greatly reduced, the demands upon the wood have multiplied, and since the larger area has been so greatly reduced in supplying the smaller demand how will the smaller area supply the larger consumption?

From the above facts it is evident, that unless measures are speedily taken to replace by plantation, the supplies consumed in the destruction of our old forests, there will be an actual famine for wood in this country within the next thirty years. Can this matter of forest culture be sefely left to private enterprise?

A period from eighty to two hundred years is required for the growth and maturity of valuable forest trees. Now, if so many neglect to plant fruit trees and grape vines, the product of which they can enjoy in a few years, will they plant forest trees, whose completed growth they will never see? To carry on the culture of forest trees successfully, it is also necessary that extensive regions should be devoted to it, for the trees that from year to year are ready for the woodman's axe, are necessarily a considerable distance apart. In small, isolated areas there could not be an econonomical adaptation of the means to the end. Forest culture can only be carried on upon a large scale.

But there is still another reason why the supply of timber cannot be left to private parties. There is needed for the profitable growth of forest

trees a scientific and technical knowledge which few farmers have it in their power to acquire. This knowledge, so far as it is not purely scientific, must necessarily be traditional. It cannot be acquired by personal experience. The mistakes of one year cannot be discovered as in the case of ordinary farm crops, by the immediate results, for the tree's life outmeasures man's. The cultivator sees his error, if at all, when it is too late to remedy it.

In Germany therefore, where these facts are fully appreciated, the forester has to undergo a special scientific and technical education. He has to serve a long apprenticeship. The culture of trees and the management of the forests becomes the business and study of his life.

From all this and numerous other reasons, it is evident that upon the government rests the necessity and duty of providing against the anticipated deficiency in the supply of timber, by initiating and controling the plantation of new forests as well as the preservation of the old.

It is not neceseary to cite the disastrous consequences which have occured in those parts of the globe where the destruction of forests has taken place, and which have been described by travelers in a most alarming manner. They are doubtless as familiar to others as to myself.

In 1869 I sent a memorial to congress in respect to the destruction of the old forests. I have not changed my opinion on this subject since and believe that it cannot be refuted. I hope that all farsighted men will share it with me and assist me in my patriotic recommendation.

MEMORIAL.

To the Honorable Senate and House of Representatives,

of the State of Minnesota, St. Paul.

The undersigned, animated by the conviction, that the subject here treated is of a most important nature for our State and well worthy your attention and thorough consideration, lays the same most respectfully before your Honorable Body, the subject is:

THE FORESTS OF THE STATE.

Experience teaches, that the majority of the people of this State as well as of the whole country are ignorant of the necessity of having at least one-quarter to one-third of the whole area of a country covered with forest tree growth, if that country is to be healthy and its climate salubrious, to fulfill the conditions, under which agriculture may be carried on with the assurance of success.

To overcome this ignorance and apathy and to convince the general public and especially the farmers of the importance, necessity and blessings of the forests for each country as servants and agents to carry out natures great plans, I have endeavored to lay down in a treatise such facts and truth, which are according to experience and science in unison with the workings of nature in regard to forests.

As the forests upon the public land are by far not sufficient, even if left for the production of timber for all future time and are not so distributed over the State to benefit agriculture and the general wellfare uniformly, it is left to the farmers to produce the surplus. It becomes therefore the duty of the people and Legislature to give him all the inducements in their power and open all resources for his instruction in the art and science of forest culture to avoid failures in his noble undertaking for the benefit of the State and the country.

The consequences which have followed the distruction of the forests in other countries are too serious to be visited upon and repeated in this prosperous land and it cannot be denied that the sudden changes of temperature, the severity of climate, the frequent occurrances of high floods and the sometimes long lasting droughts we now endure were not formerly known in this country, and the hurricanes and cyclones, which sometimes break loose upon sections of this country, dealing destruction and death in their path, are of late origin with us and are a warning signal to stop and not ruin the country by deforesting it in the crazy hunt after the almighty dollar. Equal causes have equal results, such occurances took place in all those countries, where the forests have been ruined.

This, your Honorable Body, is a subject in which every inhabitant of

the country should be interested personally and individually and the narrowest selfishness as well as the most kindly and broadest philanthropy and patriotism should lead us to due consideration of it and then to the adoption of such measures as will adequately provide for the improved condition of the forests and thereby to the material prosperity of our State and commonwealth.

The memorialist most respectfully recommends for your wise and intelligent legislation the consideration of the following points:

1. The distribution of a book among farmers and land owners, treating upon this subject in a digestible language for everybody.

2. To encourage and animate farmers to plant trees, especially such, which will fulfil the requirement of the market and will have a market value for the owner when matured.

3. Advice and instructions as to the fitness of their soil for certain kinds of trees, &c., by a competent professional.

4. The same advice in regard to treatment of already existing groves of trees.

5. The establishment of experimental stations, where to try new and more useful varieties.

6. The pushing and bringing the forests gradually to such places which are not fit for the production of farm crops, especially hills, mountains or to places with poor soil, &c.

7. The planting of shade trees along roads and all places, where nothing else can be profitably produced, so as to make use of every foot of land.

8. The ascertaining of the area of existing forests in the State and their condition and nature.

9. The improvement of the forests as well as the farm land by drainage, where necessary.

10. The printing of condensed annual reports for distribution among farmers, &c., containing the experience made during the year, etc.

11. The passing of strict laws against fire, cattle and men.

12. Petitioning Congress to transfer the public land to the State, while the State in return pledges to maintain the same, or turn it into forest growth for all future time.

Hoping that your Honorable Body will give that attention to this subject, which the importance of the same deserves.

Very Respectfully,

Minneapolis, January, 1887. P. P. SCHOTZKA.

CHAPTER XXVII.

TREES PER ACRE.

The following table gives the number of trees on an acre, at various distances apart:

Rows Apart, Feet.	Plants Apart in rows, Feet.	Number of Plants.	Rows Apart, Feet.	Plants Apart in rows, Feet.	Number of Plants.
2	2	10,890	7	2	3,111
3	2	7,260	7	3	2,074
3	3	4,840	7	4	1,556
4	3	3,630	7	5	1,246
4	2	5,445	7	6	1,037
4	4	2,722	7	7	880
5	4	2,178	8	2	2,722
5	2	4,356	8	3	1,815
5	3	2,904	8	4	1,316
5	4	2,178	8	5	1,098
5	5	1,742	8	6	907
6	2	3,630	8	7	778
6	3	2,904	8	8	681
6	4	1,815	12	12	302
5	5	1,452	16	16	170
5	6	1,210			

CHAPTER XXVIII.

VALUE OF THE DIFFERENT SPECIES OF WOOD AS FUEL.

The following table is useful as showing the relative value of various kinds of wood for fuel, taking Shell-bark Hickory as the standard at 100.

Shell-bark Hickory	100	White Elm	58
Pig-nut Hickory	96	Red Cedar	56
White Oak	81	Wild Cherry	55
White Ash	77	Soft Maple	54
Black Oak	71	Yellow Popular	52
Red Oak	69	Butternut	51
Black Walnut	65	White Birch	48
White Beech	65	White Pine	42
Black Birch	63	Lombardy Poplar	40
Hard Maple	60		

CHAPTER XXIX.

FOREST TREES AS PROTECTORS OF FRUIT TREES IN UNFAVORABLE CLIMES.

In the creation, the careful observer will find that one creature is dependent upon others and is bound to serve nature in the fulfillments of her plans, to beautify the earth. That the assistant and servant is frequently badly paid by the assisted for his services is the run of the world. So is the thin, wimsy creeper, running up the majestic trunk of a tree, and while not able without such an assistant to rise even a foot from the ground that nature's servant enables that helpless creature to grow up to the very top of him, and twist his thin but strong branches around those of its giant supporter, and in many cases takes the very life out of its benefactor. Many a creeping and sucking creature thanks her existence to the support received by the trees in the forests.

But the forest trees do not only show their existing qualities to nature inside of their own domain, but their beneficial influence as mentioned in other parts of these pages, extends to much farther limits, and most probably are their great beneficial services as nature's assistants, not half fully known, or at least not appreciated by most of those that enjoy their blessings daily.

The variety of the forest trees shows to the thinking man, who has a particle of appreciation and sympathy for the beautiful forests of the country, that as various as their variety, must be their services to the human family. The writer of this treatise had the opportunity to observe in the milder climate of Westchester county, New York, the following facts and beneficial influences of forest trees to fruit trees.

An orchard located in a low valley near a pond or lake, protected by mountains from the north and partially from the west, exposed to the east and south sun, was in a poor condition; the trees half dead, very dwarf and here and there with an apple upon the neglected trees, while in one

corner forest trees had grown between two apple trees belonging to the same orchard and planted with the rest of the orchard trees, but what a contrast between those two trees and those of the rest in the orchard without the protection of forest trees. The dwarf habit, in the desire and effort to keep up in growth with the forest trees to gain light, had been abandoned. The rough bark of the branches had changed to the most smooth, shining and the trees were loaded with beautiful apples, for the benefit of our game bags, as we were hunting.

In Wisconsin, near Madison, a similar occurrance was observed. A nursery for temporary use had been started at one end of the orchard, and after most of the shade trees and Evergreens had been disposed of at other places, some ot the deciduous trees had been left around two orchard trees, and some Scotch fire or Spruce near the trees. The deciduous trees were two Soft Maples and one Elm, and the beneficial assistance of those trees to the fruit trees were astonishing, and in their effects fully up to those observed in Westchester, N. Y.

Why not consider the above as a wink from kind Nature to assist us in those parts of the country in the raising of apples, where the realization of this task belongs almost to the impossible? The Spruce, even if planted near the trunks of apple trees, will not take much nourishment from the latter, as her roots run right underneath the surface, and the deciduous trees can be planted far enough from the fruit trees, not coming much in contact with the latter and all trees together will prevent the leaves in autumn to be driven away and the ground will be well shaded to keep the burning sun from it. The Spruce is intended for the protiction of the trunks and the deciduous trees that of the branches, and either or both can be trimmed if too much shade is produced. It is anyhow worth while, giving this subject a little consideration, as in former times, Germany grew such an abundance of wild apples in their forest area that farmers fatten their pigs upon them and upon acorns.

In taking good bye the author wishes and hopes that all who peruse these pages may arrive at the same conclusion—that of preserving and advancing the forests of the country, and that each may lend his assistance to divert the calamity which must neccessarily follow the destruction of the forests.

THE END.

TABLE OF CONTENTS.

Preface . . . . . .

Introductory . . . . . .

Chapter I. Consequences of deforesting 10

Chapter II. Causes of decrease of our Forests 11

Chapter III. Forests in their present and future state 13

1. Second or third growth;
2. Groves of trees which supply the wants of farmers;
3. Forests situated in swamps and marshes;
3. Evergreen Forests;
5. Primeval Forests.

Chapter IV. Forests as natures agents to fulfil her plans. 16

1. Forests beautify the earth and improve the character of its inhabitants.
2. Forests help to sustain the relative proportion of the component properties of atmospheric air and purify it from unhealthy substances and obnoxious gases.
3. Extensive forests prevent sudden and extreme changes in the temperature.
4. Abundant forests effect climate by regulating the moisture and electricity of the atmosphere.
5. Forests as protection against grasshoppers.
6. Forests as supplier of fuel and building material.
7. Forests as preventative of malaria, etc.
8. Forests as markets for game and fur.
9. Forests as supplier of plants for medical purposes etc.

Chapter V. Treatment of Forests, so far, not destructed. 19

Chapter VI. Treatment of Forests in this and other countries.. 26

Chapter VII. Preparing soils for seeds of Forests. 30

Chapter VIII. Selection of Seeds. 32

Chapter IX. Advantages of a Nursery. 33
Chapter X. Results from increase of population. 34
Chapter XI. Production of timber. 36
Chapter XII. Matters to be considered in forestry. 38
Chapter XIII. Selection of trees. 40
Chapter XIV. Mixed forests. 53
Chapter XV. Drainage of forests 58
Chapter XVI. The thinning of forests. 60
Chapter XVII. Damages to forests. 62
1. By Insects.
2. By heavy frosts.
3. By the Sun.
4. By wind.
5. By snow.
6. By water.
Chapter XVIII. Rotation of species in forests. 66
Chapter XIX. The harvest. 67
Chapter XX. The future of the Southern forests. 69
Chapter XXI. Prunning of trees 70
Chapter XXII. Planting of trees in cities. 72
Chapter XXIII. Planting of large trees and transplanting 75
Chapter XXIV. Railroads as timber consumers. 77
Chapter XXV. Duty of the Government, by E. P. Parker, U. S. Forestry Agent. 79
Chapter XXVI. A paper read by the Author before the Wisconsin State Agricultural Society, Madison, Wis. 83
Chapter XXVII. Number of trees per acre. 89
Chapter XXVIII. Value of the different species of wood as fuel. 90
Chapter XXIX. Forest trees as protector of fruit trees in unfavorable climes. 91

TO THE PUBLIC.

The undersigned introduce themselves respectfully to all parties desiring services of below named nature, after an experience of twenty-five years, gained in most of the leading parks of this country and in all departments of their construction, and assure those that will patronize them and engage their services, that they will not be bound to pay any apprentice money in the execution of their work.

We offer our services for a reasonable compensation, without charging those fancy or novelty prices which are a source of discouragement for many, to secure the services of real experienced professionals.

Our field of duty will be confined mainly to the following:

1.—As a foundation for all kind of improvement requires a plan to work by, we will, when necessary, supply each party engaging our services, with a most thorough studied plan, and as a preliminary work for a plan, make the necessary survey.

2.—We will transfer such plan after adopted. upon the ground, give required grades, in general, do all work pertaining to the Civil Engineer and Landscape Gardner.

3.—We will execute the work from the beginning to the end if desired.

4.—The supplying and planting of the necessary trees and shrubs, &c., shall have our full attention, and only the best of trees shall be supplied, and success guaranteed.

5.—The planning and laying out, as well as improving of Cemeteries, shall form a branch of our business.

6.—The drainage of farm and other land will be executed after the latest methods, and combined with irrigation during the dry season where practicable, possible and desired.

7.—The improvement of private parks and gardens of small dimensions, will receive our attention as well as a thousand acre park.

8.—Our advice in regard to intended improvements will be cheerfully given.

9.—Parties wishing estimates of costs of excavations or fillings to be made, will go safe if employing our services.

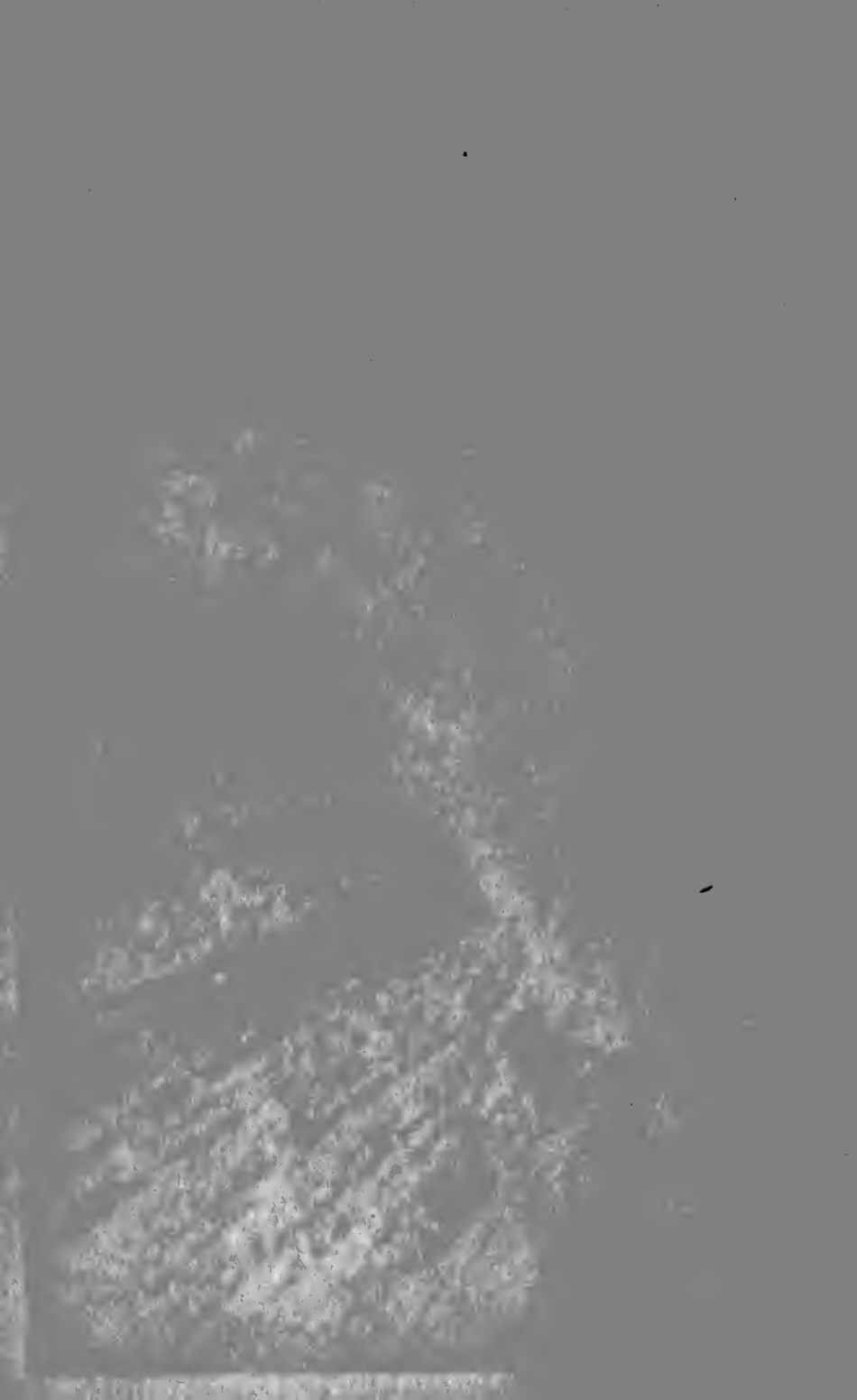
Hoping that the public will reward us with full confidence and patronize us by sending us their orders, and direct to

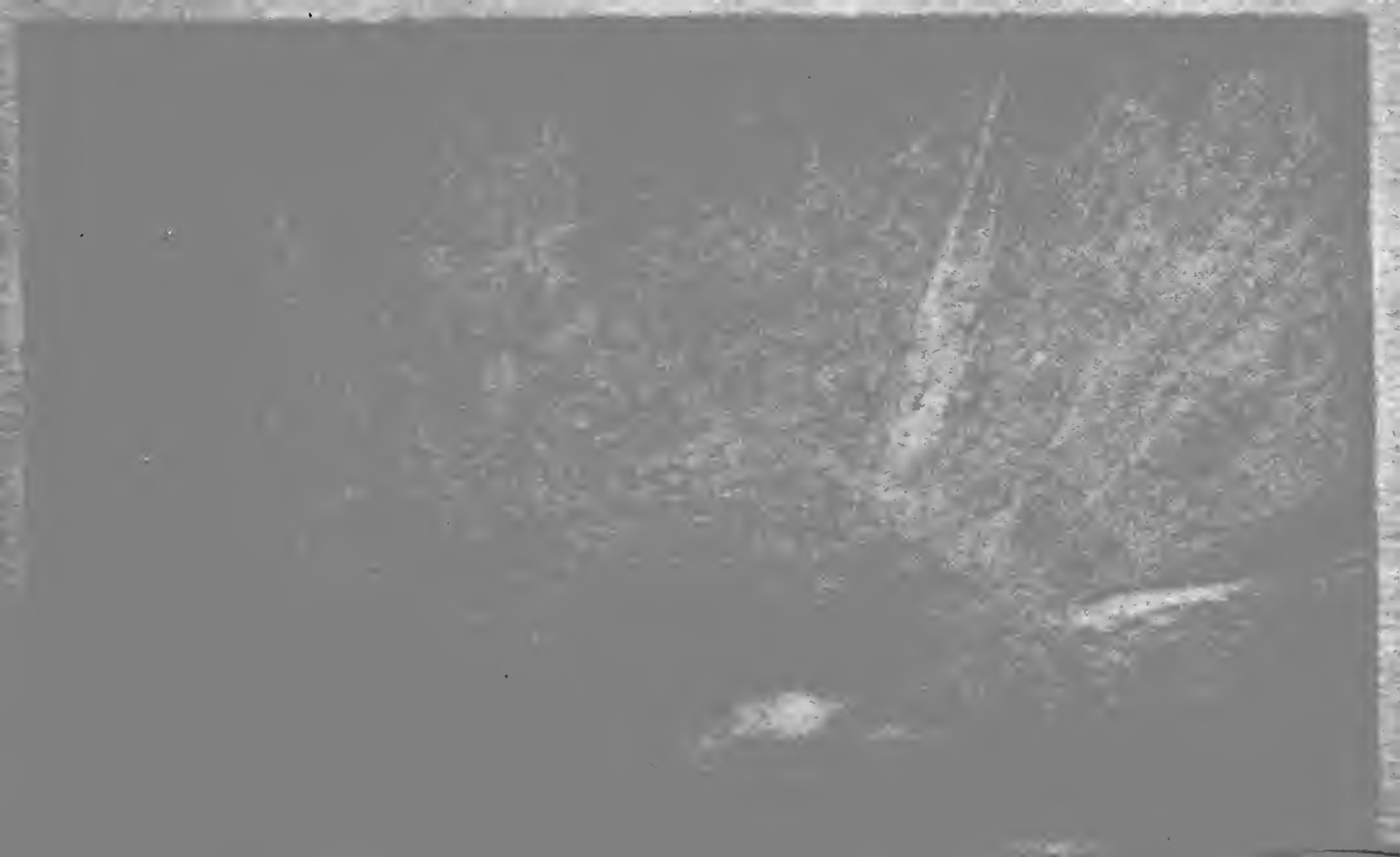
P. P. SCHOTZKA & CO.,
Civil Engineers & Landscape Gardeners,
No. 611 25th Ave. South.

REFERENCES.

From Central Park, New York.
" Prospect park, Brooklyn, N. Y.
" Albany, New York.
" West Chicago Parks, Illinois.
" Lakewood Cemetery, Minneapolis. Minn.
" Minneapolis City Parks, Minn.,

At the latter place planted besides other work, nine thousand shade and ornamental trees, with unequaled success.





LIBRARY OF CONGRESS
0 002 818 645 9